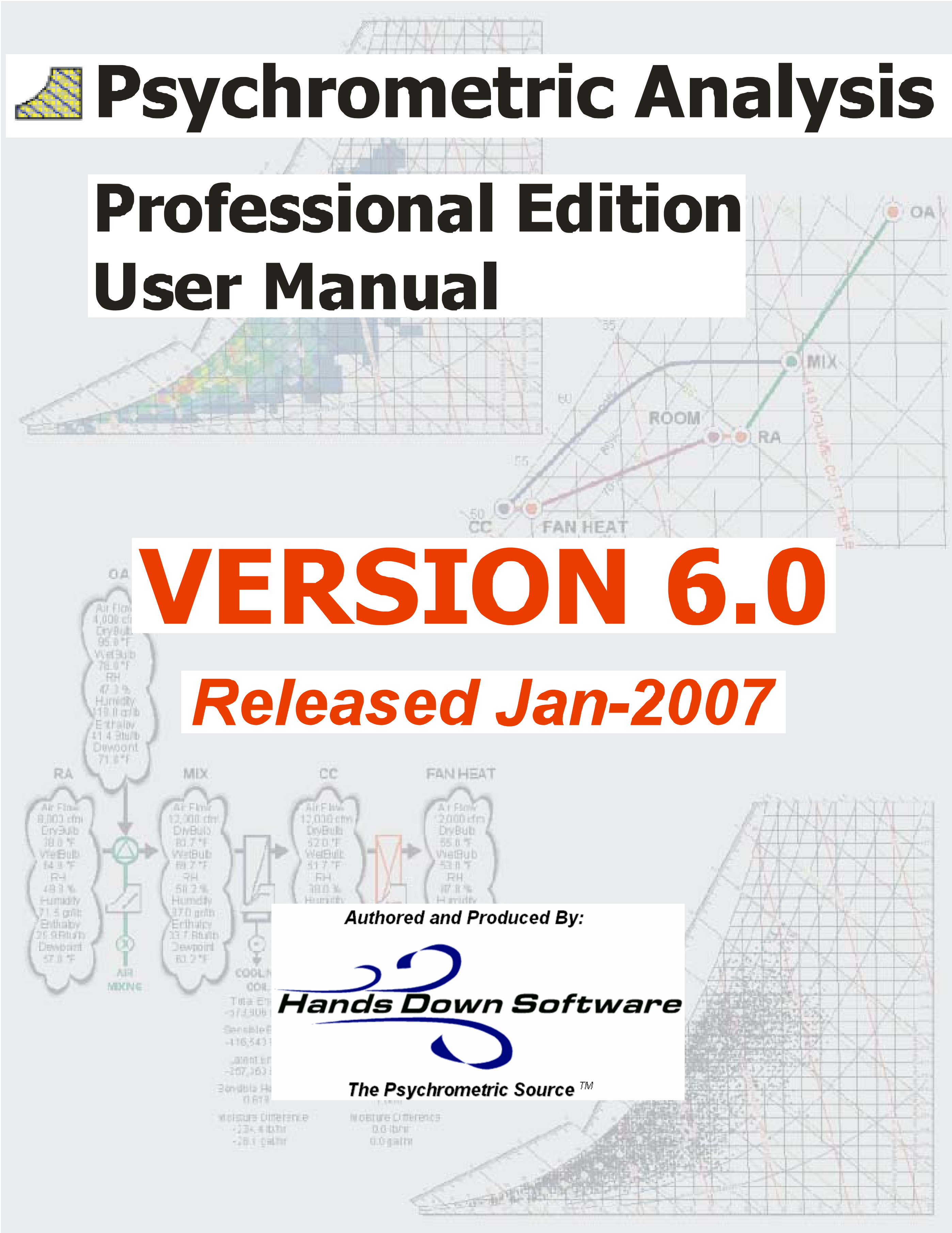
Psychrometric Analysis

Professional Edition User Manual



VERSION 6.0

Released Jan-2007

Authored and Produced By:

Hands Down Software

The Psychrometric Source ™

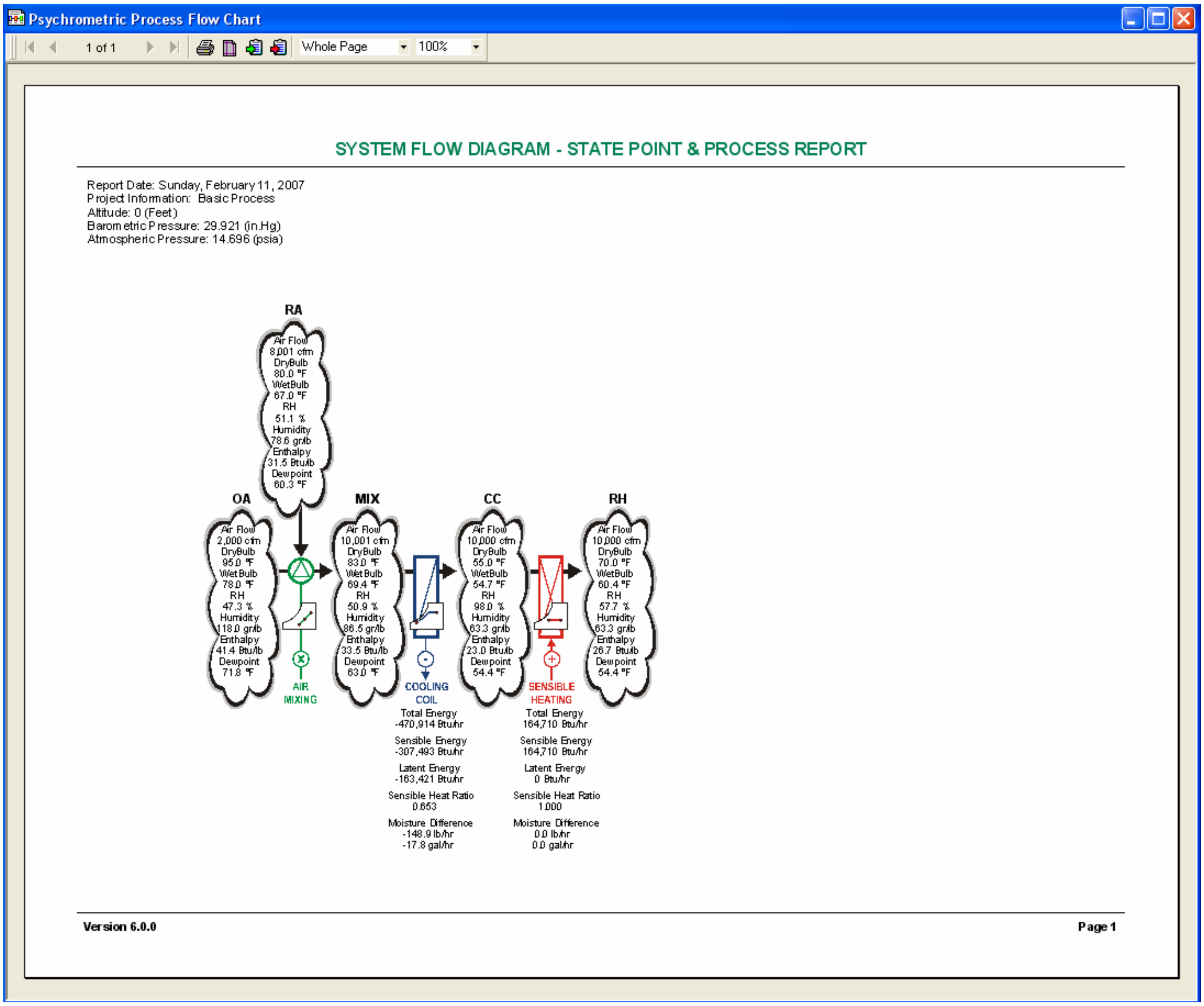
TABLE OF CONTENTS

PROGRAM FEATURES

NEW VERSION 6 FEATURES!

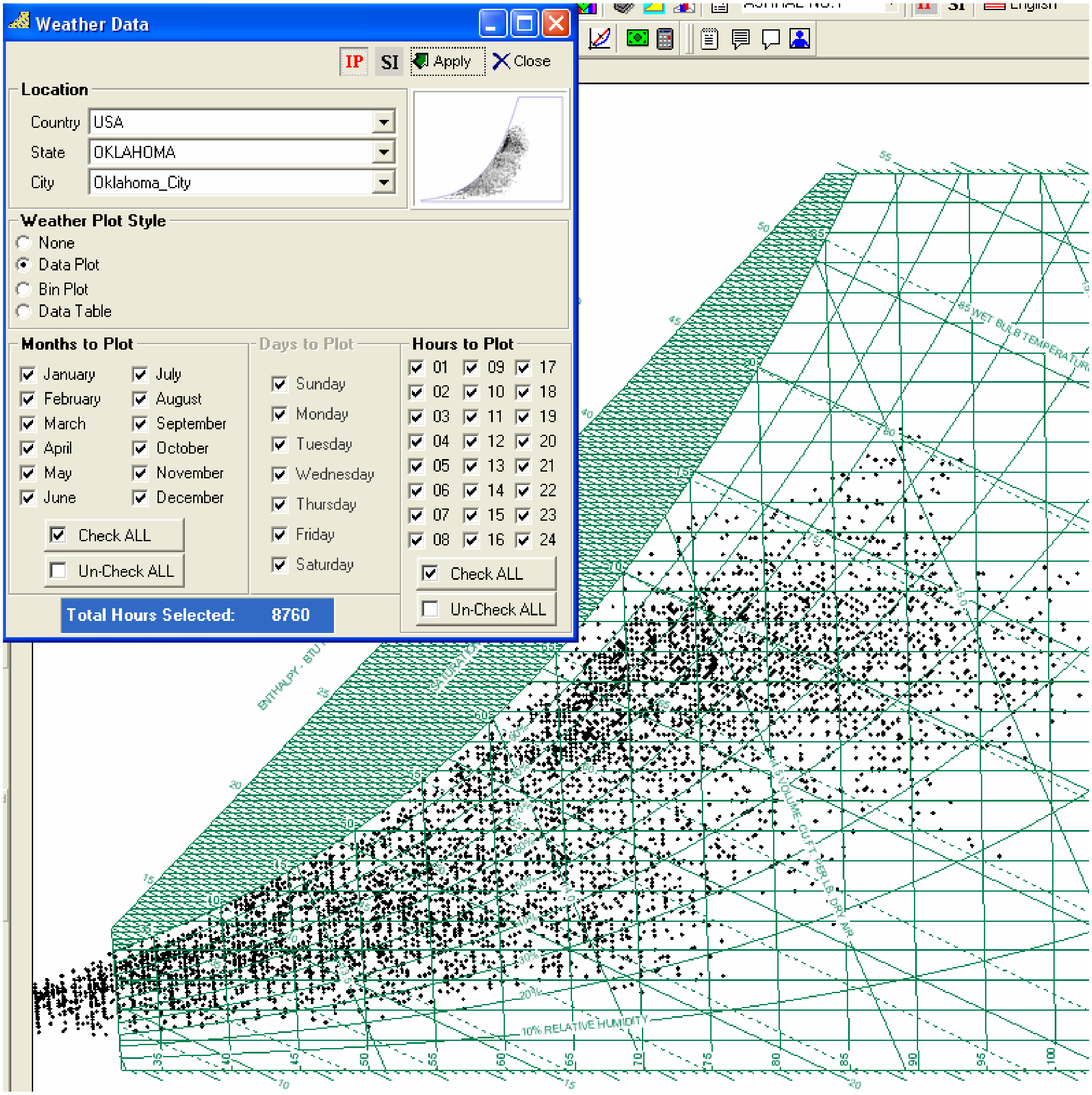
NEW Auto Flow Chart Diagram!

Now you can get a Complete Flow Diagram Schematic with all Process and Thermo-Physical properties with One-Button-Click! Flow diagram and/or data can be copied with One-Button-Click to the clipboard for pasting into your reports and presentations!



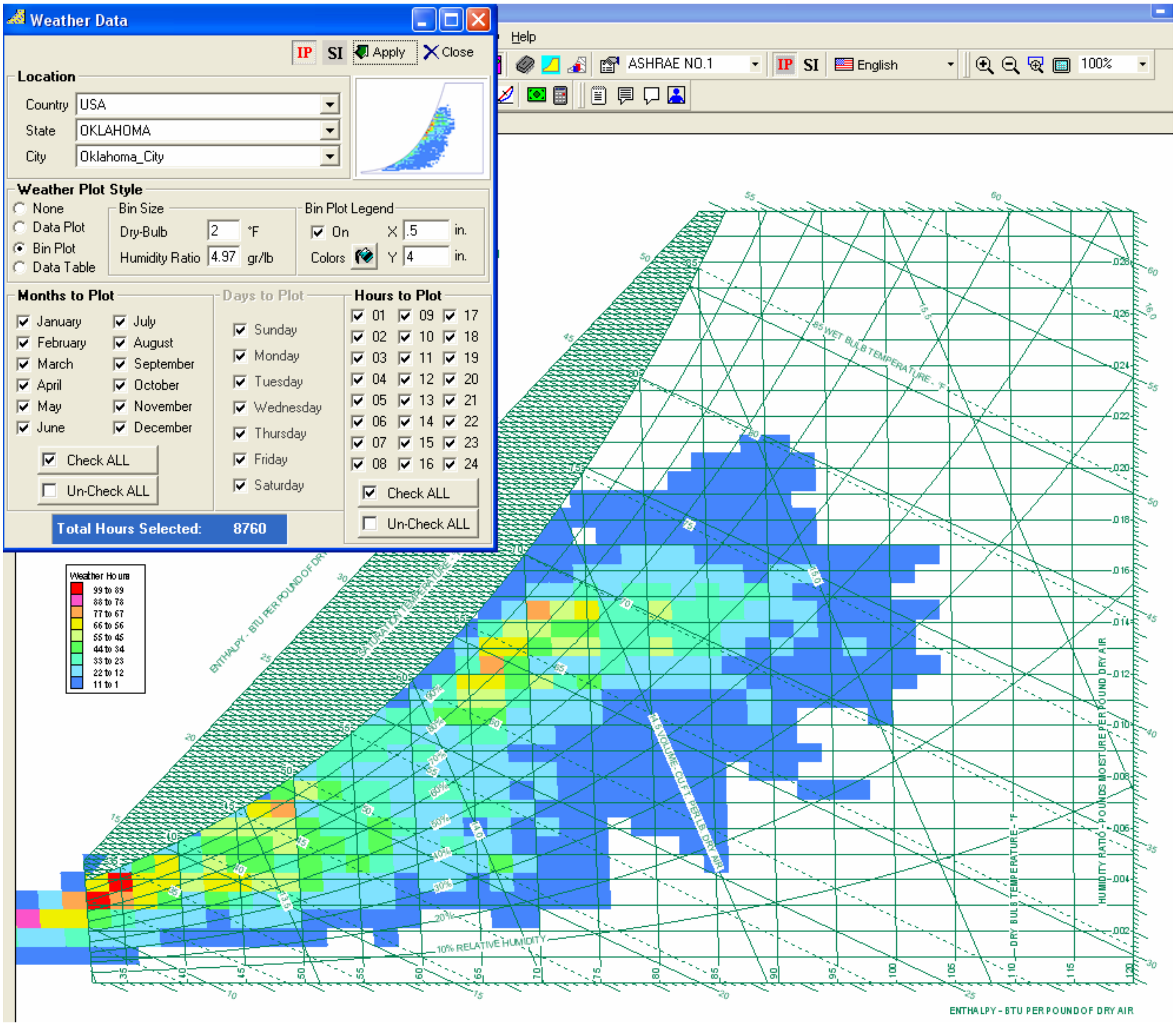
NEW Weather Data Plotting with Complete Global Weather Files!!

Now you can see the weather data plotted right on the chart with one click!!



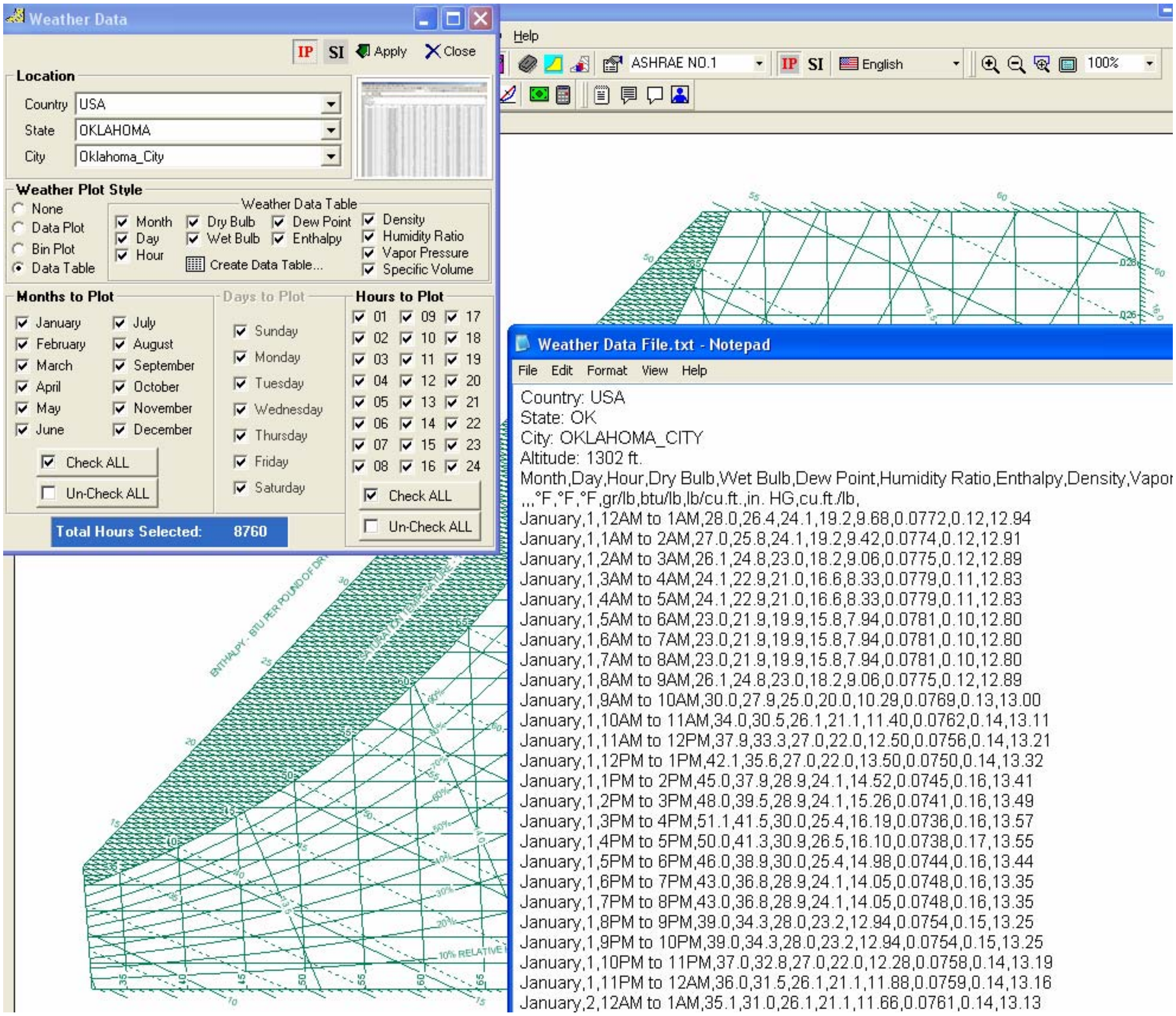
NEW Weather Bin Shade Plotting with Complete Control!!

Now you can display Bin Weather data right on the chart and specify the bin size and colors!!...even displays a bin legend that you can locate where you want!!



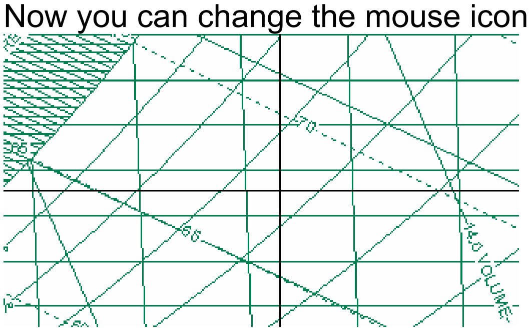
NEW Global Weather Data Table Access!!...CREATE YOUR OWN BIN TABLES!!

Now you have access to world-wide weather data at your fingertips!!...create a complete weather data file that you can modify, import to Excel, etc. with One-Click!!

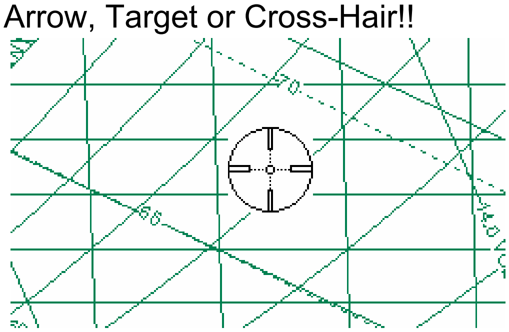


NEW Mouse Icon Control!!

Now you can change the mouse icon to Arrow, Target or Cross-Hair!!



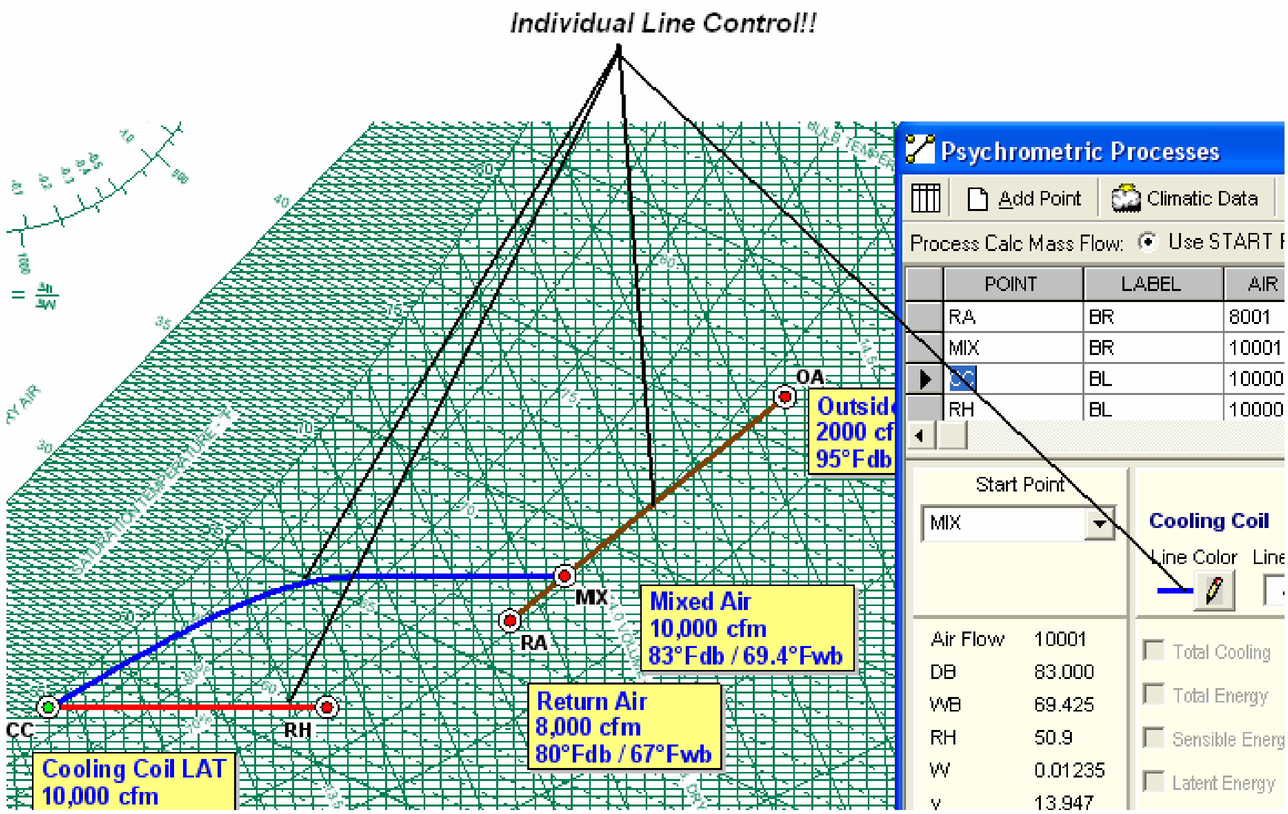
Cross-Hair Mouse (just like CAD!!)



Or Target Style!!

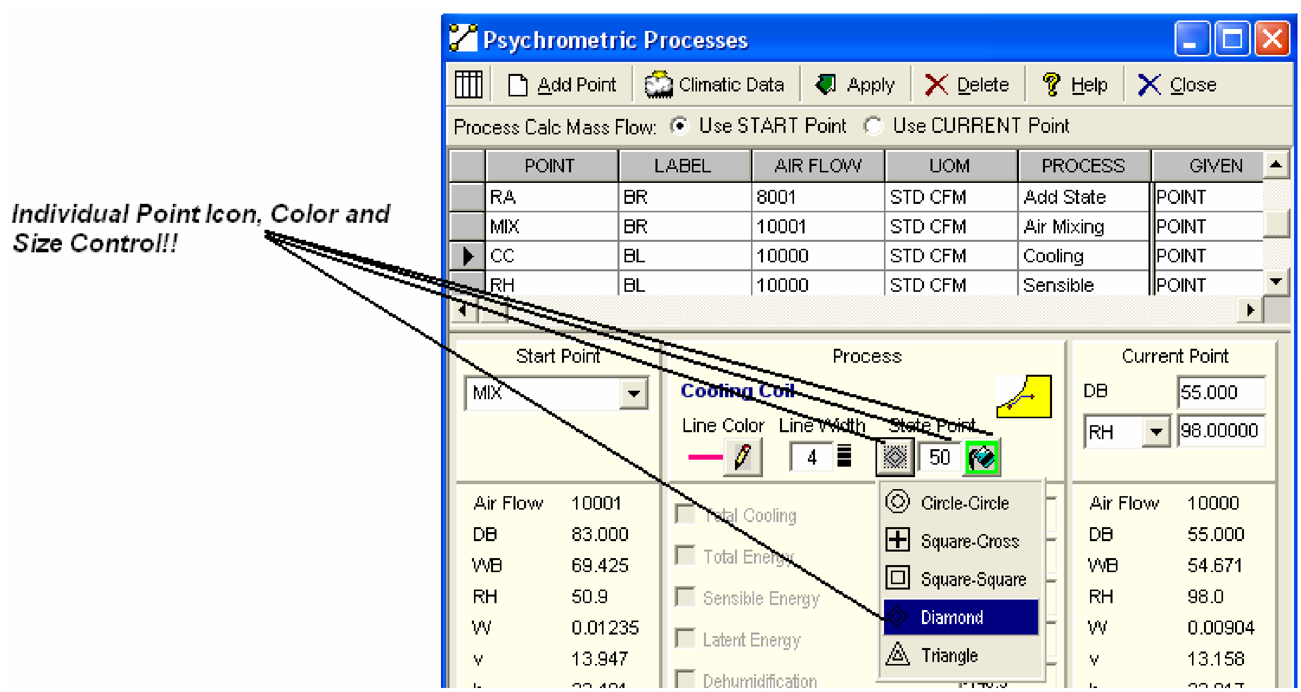
NEW Individual Process Line Color Control!

Now you can control the color and thickness of EACH Individual Process Line!!



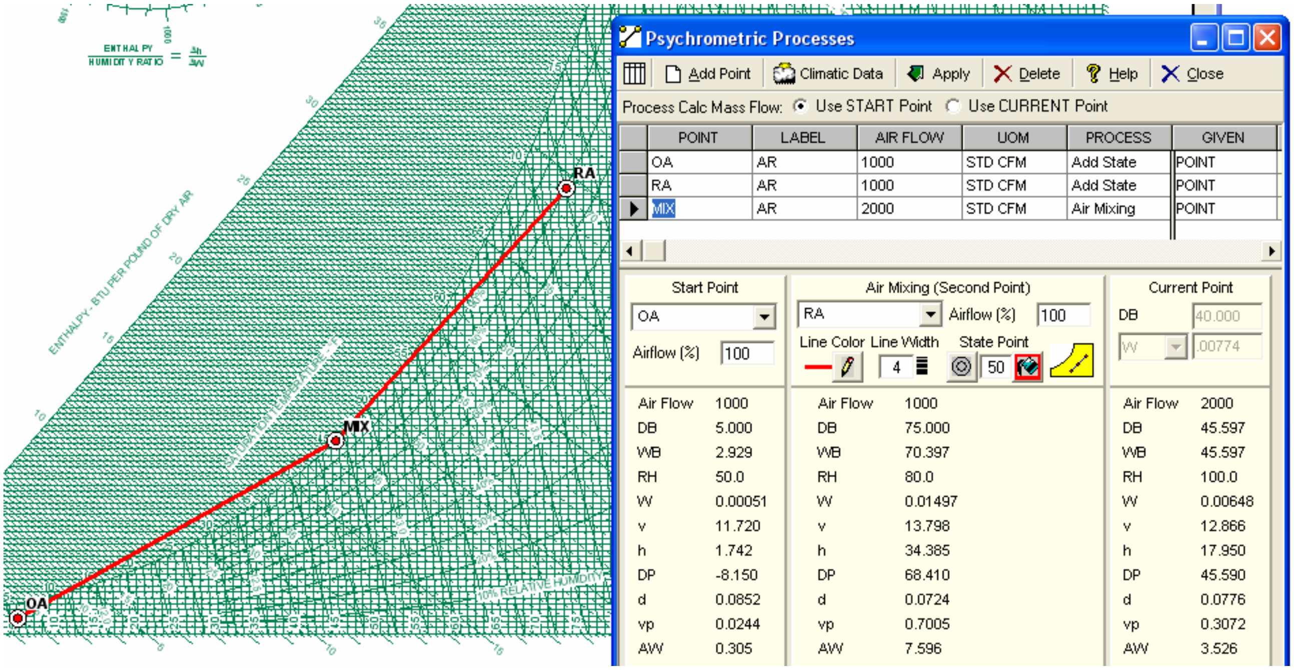
NEW Individual Point Color, Shape and Size Control!

Now you can control the icon, color and size of EACH Individual State Point!!



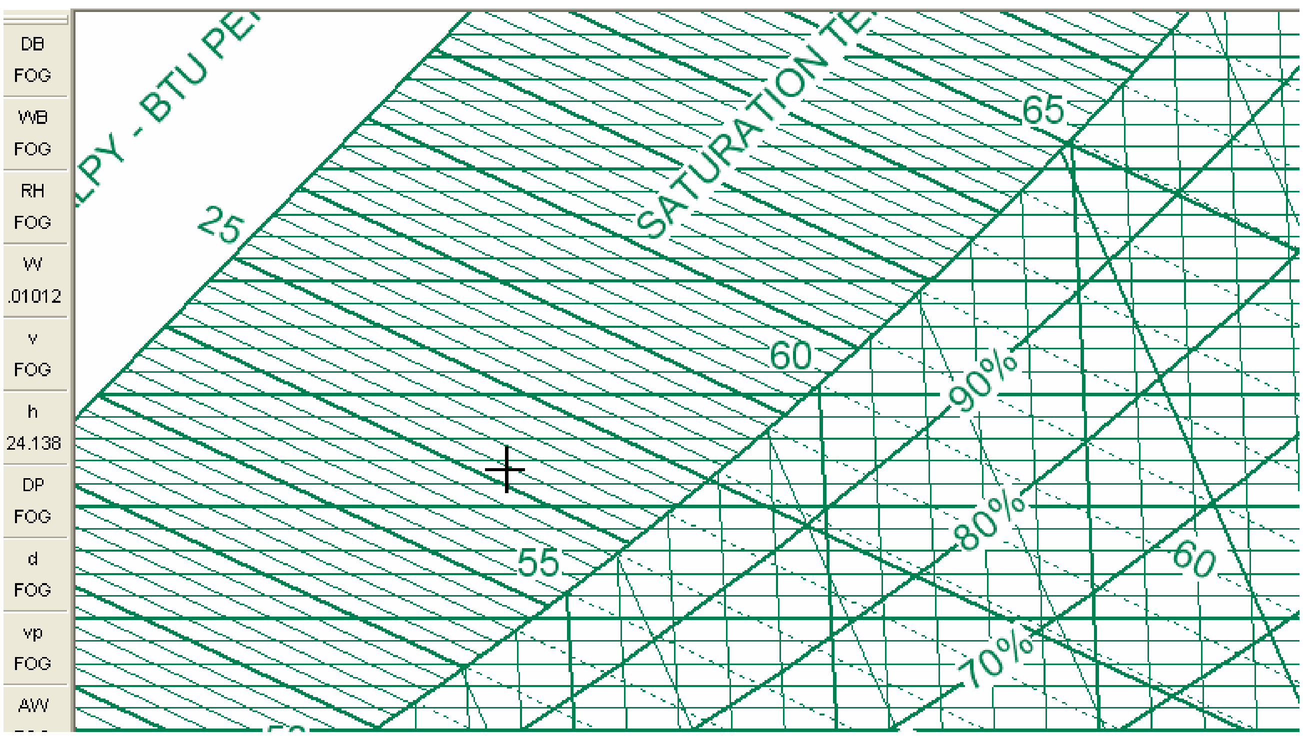
NEW Winter "V" Air Mixing Capability!

Now you can plot mixing processes that cross the saturation line!!



NEW Fog Region Property Display!!

Now you can read fog region properties!!



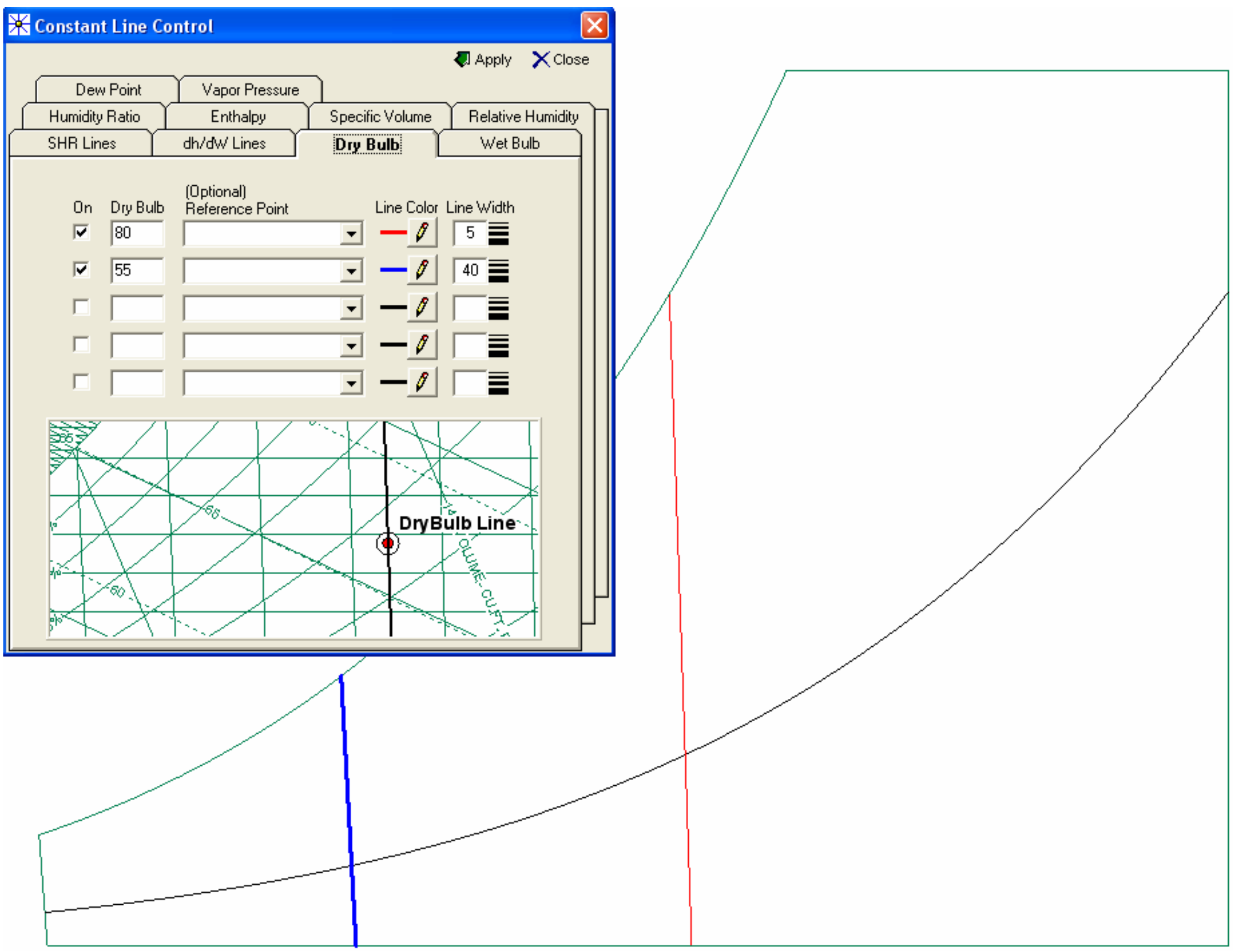
NEW Humidity Ratio Unit of Measure Control!!

Now you can select the Humidity Ratio units displayed on the chart and used in Psychrometric Analysis with one button click!!



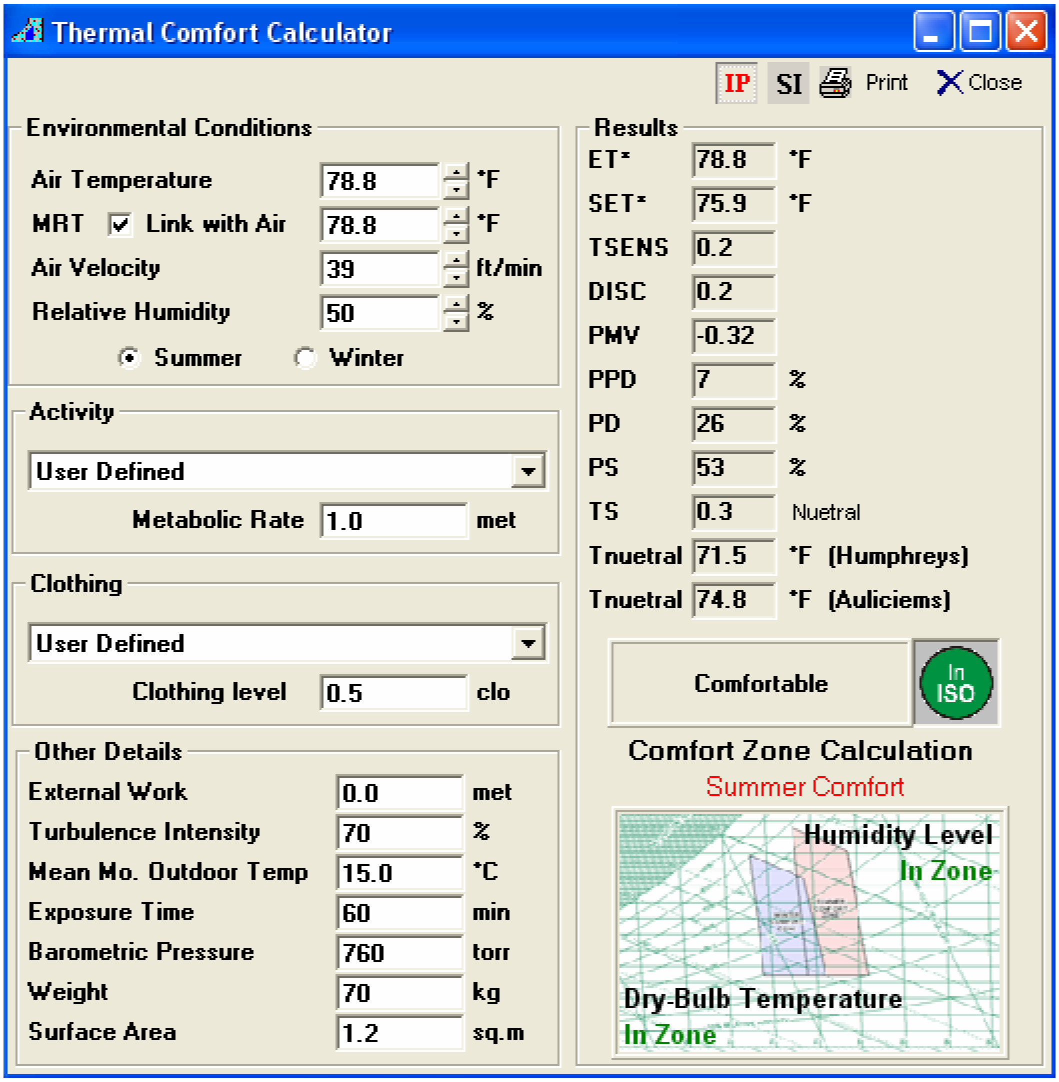
NEW Constant h, WB, HR, DB, VP, DP, SHR & dW/dh Line Control!!

Now you can specify exact individual property lines to be displayed!!



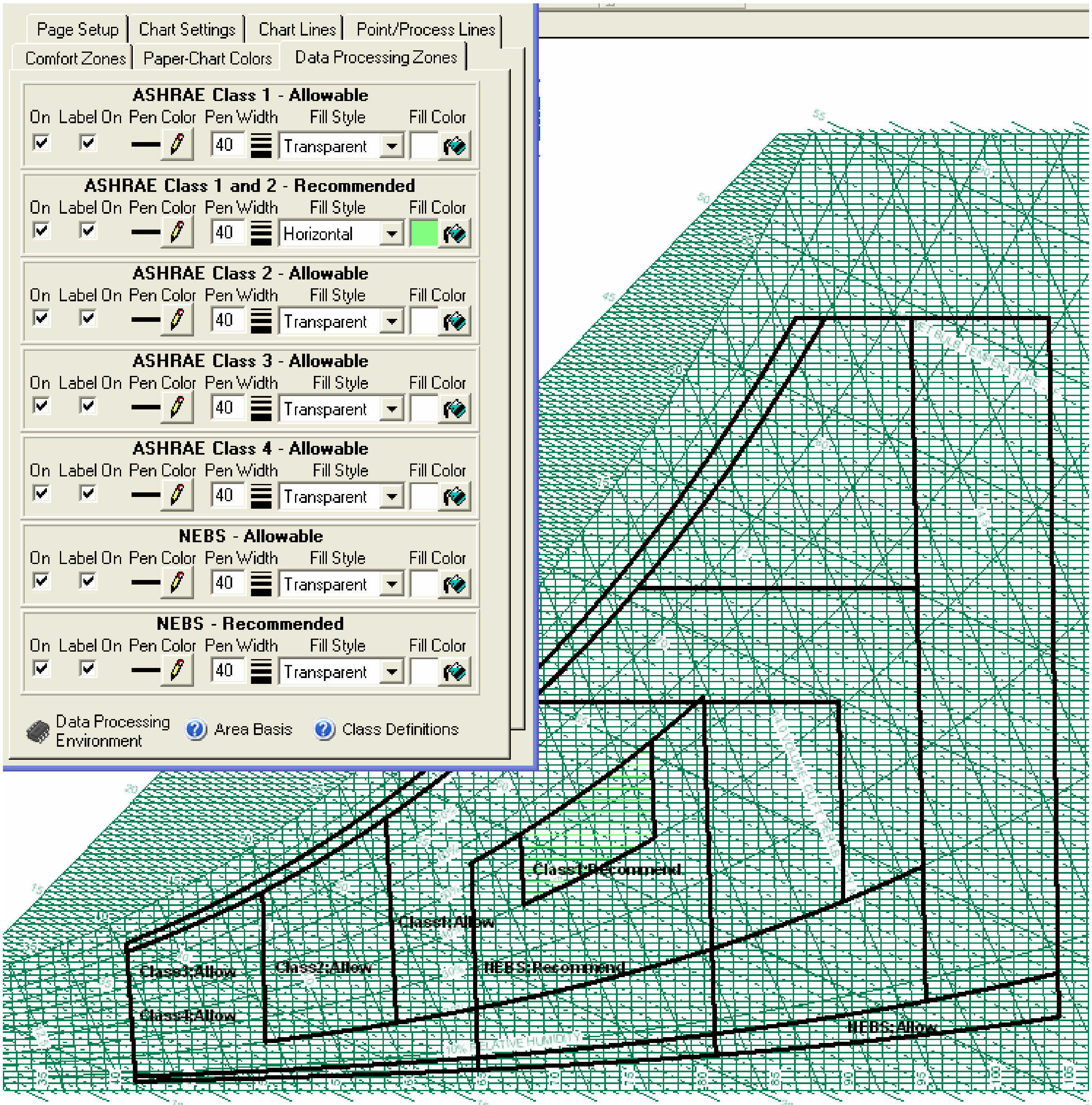
NEW Complete Thermal Comfort Calculator!!

Now you can perform thermal comfort modeling calculations on the fly!!



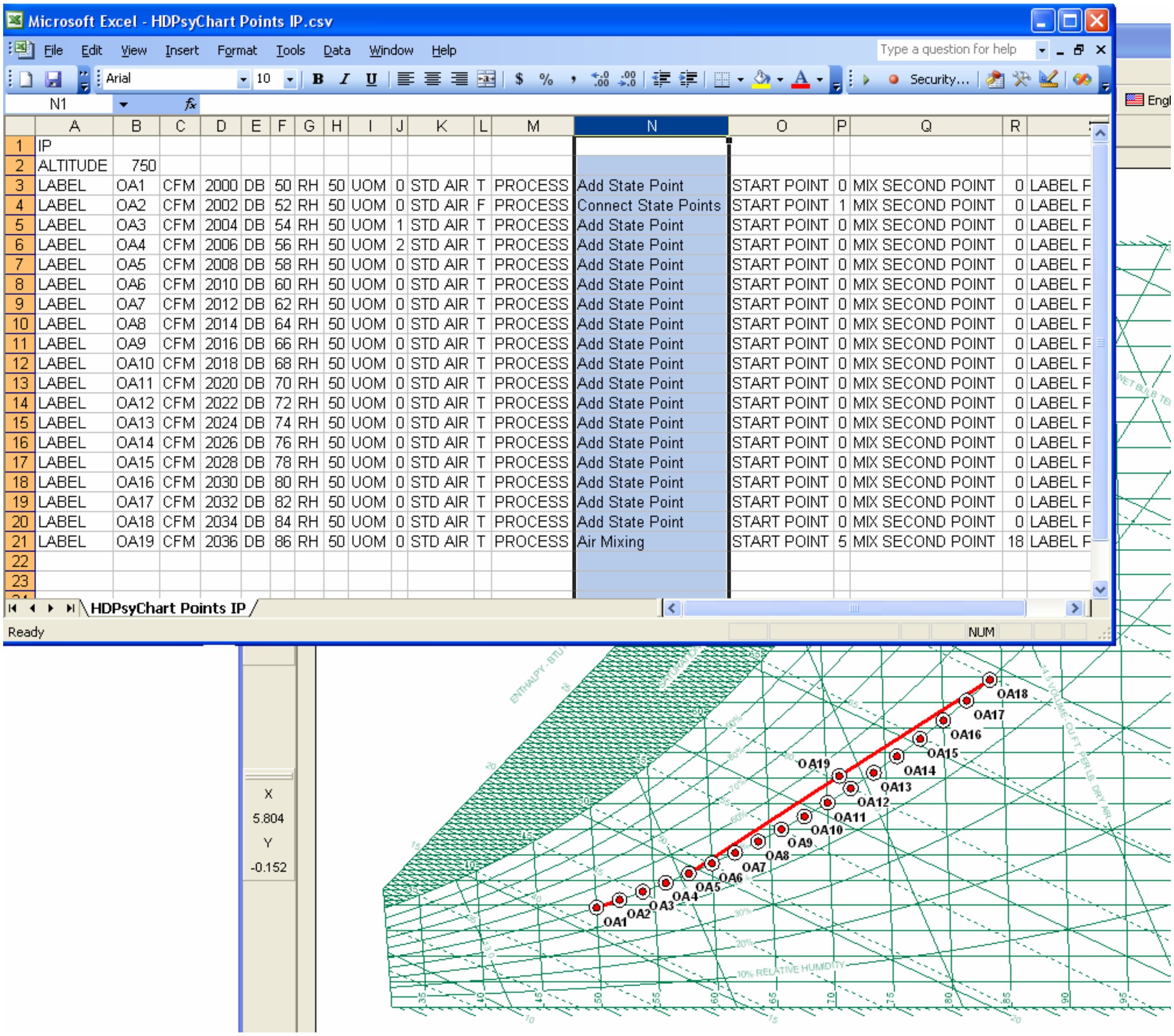
NEW ASHRAE Class 1 through 4 Datacenter Zones (allowed & recommended) and NEBS Datacenter Zones (allowed & recommended)!!

Now you can display the Data Processing Environment regions right on the psychrometric chart!!!...the regions are calculated and are displayed dynamically with elevation!!!



NEW Process Control added to Data Import Function!!

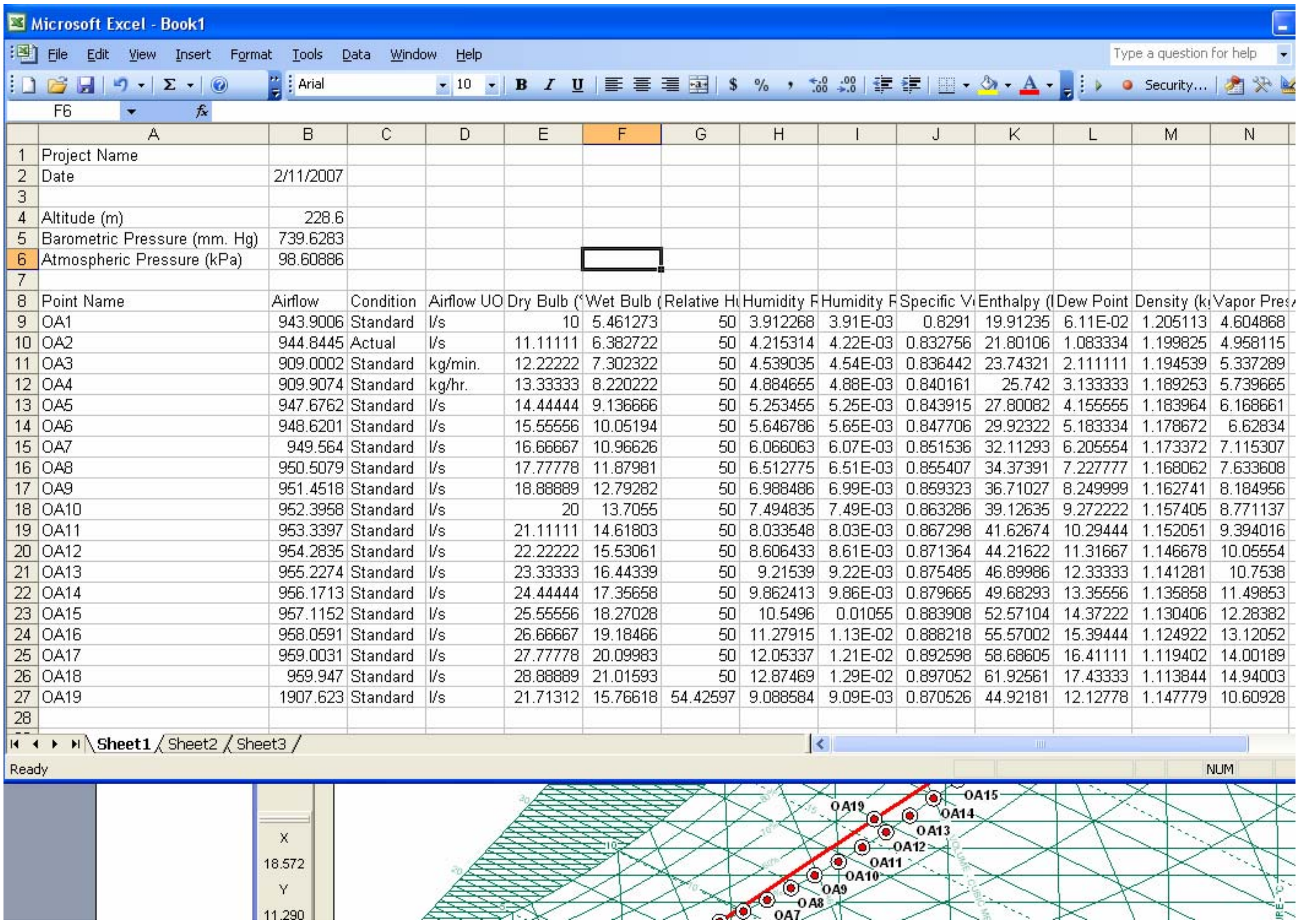
Now when you’re importing data text or Excel spreadsheet data, you can specify processes with the data!!



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	IP																		
2	ALTITUDE	750																	
3	LABEL	OA1	CFM	2000	DB	50	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
4	LABEL	OA2	CFM	2002	DB	52	RH	50	UOM	0	STD AIR	F	PROCESS	Connect State Points	START POINT	1	MIX SECOND POINT	0	LABEL F
5	LABEL	OA3	CFM	2004	DB	54	RH	50	UOM	1	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
6	LABEL	OA4	CFM	2006	DB	56	RH	50	UOM	2	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
7	LABEL	OA5	CFM	2008	DB	58	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
8	LABEL	OA6	CFM	2010	DB	60	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
9	LABEL	OA7	CFM	2012	DB	62	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
10	LABEL	OA8	CFM	2014	DB	64	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
11	LABEL	OA9	CFM	2016	DB	66	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
12	LABEL	OA10	CFM	2018	DB	68	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
13	LABEL	OA11	CFM	2020	DB	70	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
14	LABEL	OA12	CFM	2022	DB	72	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
15	LABEL	OA13	CFM	2024	DB	74	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
16	LABEL	OA14	CFM	2026	DB	76	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
17	LABEL	OA15	CFM	2028	DB	78	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
18	LABEL	OA16	CFM	2030	DB	80	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
19	LABEL	OA17	CFM	2032	DB	82	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
20	LABEL	OA18	CFM	2034	DB	84	RH	50	UOM	0	STD AIR	T	PROCESS	Add State Point	START POINT	0	MIX SECOND POINT	0	LABEL F
21	LABEL	OA19	CFM	2036	DB	86	RH	50	UOM	0	STD AIR	T	PROCESS	Air Mixing	START POINT	5	MIX SECOND POINT	18	LABEL F
22																			
23																			

NEW SI units added to text file & Excel Data Exchange!!

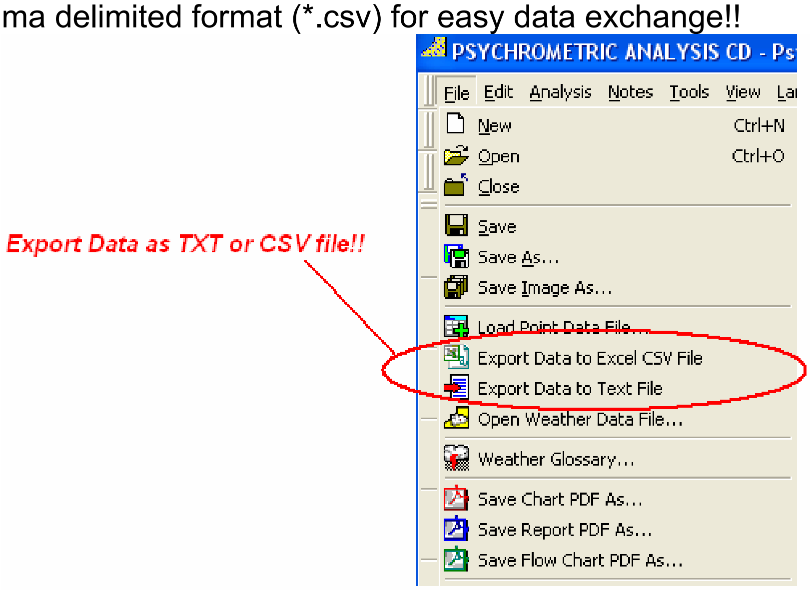
Now when you're exporting data text or Excel spreadsheet data, you can export out in SI units of measure!!



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Project Name													
2	Date	2/11/2007												
3														
4	Altitude (m)	228.6												
5	Barometric Pressure (mm. Hg)	739.6283												
6	Atmospheric Pressure (kPa)	98.60886												
7														
8	Point Name	Airflow	Condition	Airflow UO	Dry Bulb ('	Wet Bulb (	Relative Hu	Humidity R	Humidity R	Specific Vo	Enthalpy (l	Dew Point	Density (kg	Vapor Pres
9	OA1	943.9006	Standard	l/s	10	5.461273	50	3.912268	3.91E-03	0.8291	19.91235	6.11E-02	1.205113	4.604868
10	OA2	944.8445	Actual	l/s	11.11111	6.382722	50	4.215314	4.22E-03	0.832756	21.80106	1.083334	1.199825	4.958115
11	OA3	909.0002	Standard	kg/min.	12.22222	7.302322	50	4.539035	4.54E-03	0.836442	23.74321	2.111111	1.194539	5.337289
12	OA4	909.9074	Standard	kg/hr.	13.33333	8.220222	50	4.884655	4.88E-03	0.840161	25.742	3.133333	1.189253	5.739665
13	OA5	947.6762	Standard	l/s	14.44444	9.136666	50	5.253455	5.25E-03	0.843915	27.80082	4.155555	1.183964	6.168661
14	OA6	948.6201	Standard	l/s	15.55556	10.05194	50	5.646786	5.65E-03	0.847706	29.92322	5.183334	1.178672	6.62834
15	OA7	949.564	Standard	l/s	16.66667	10.96626	50	6.066063	6.07E-03	0.851536	32.11293	6.205554	1.173372	7.115307
16	OA8	950.5079	Standard	l/s	17.77778	11.87981	50	6.512775	6.51E-03	0.855407	34.37391	7.227777	1.168062	7.633608
17	OA9	951.4518	Standard	l/s	18.88889	12.79282	50	6.988486	6.99E-03	0.859323	36.71027	8.249999	1.162741	8.184956
18	OA10	952.3958	Standard	l/s	20	13.7055	50	7.494835	7.49E-03	0.863286	39.12635	9.272222	1.157405	8.771137
19	OA11	953.3397	Standard	l/s	21.11111	14.61803	50	8.033548	8.03E-03	0.867298	41.62674	10.29444	1.152051	9.394016
20	OA12	954.2835	Standard	l/s	22.22222	15.53061	50	8.606433	8.61E-03	0.871364	44.21622	11.31667	1.146678	10.05554
21	OA13	955.2274	Standard	l/s	23.33333	16.44339	50	9.21539	9.22E-03	0.875485	46.89986	12.33333	1.141281	10.7538
22	OA14	956.1713	Standard	l/s	24.44444	17.35658	50	9.862413	9.86E-03	0.879665	49.68293	13.35556	1.135858	11.49853
23	OA15	957.1152	Standard	l/s	25.55556	18.27028	50	10.5496	0.01055	0.883908	52.57104	14.37222	1.130406	12.28382
24	OA16	958.0591	Standard	l/s	26.66667	19.18466	50	11.27915	1.13E-02	0.888218	55.57002	15.39444	1.124922	13.12052
25	OA17	959.0031	Standard	l/s	27.77778	20.09983	50	12.05337	1.21E-02	0.892598	58.68605	16.41111	1.119402	14.00189
26	OA18	959.947	Standard	l/s	28.88889	21.01593	50	12.87469	1.29E-02	0.897052	61.92561	17.43333	1.113844	14.94003
27	OA19	1907.623	Standard	l/s	21.71312	15.76618	54.42597	9.088584	9.09E-03	0.870526	44.92181	12.12778	1.147779	10.60928
28														

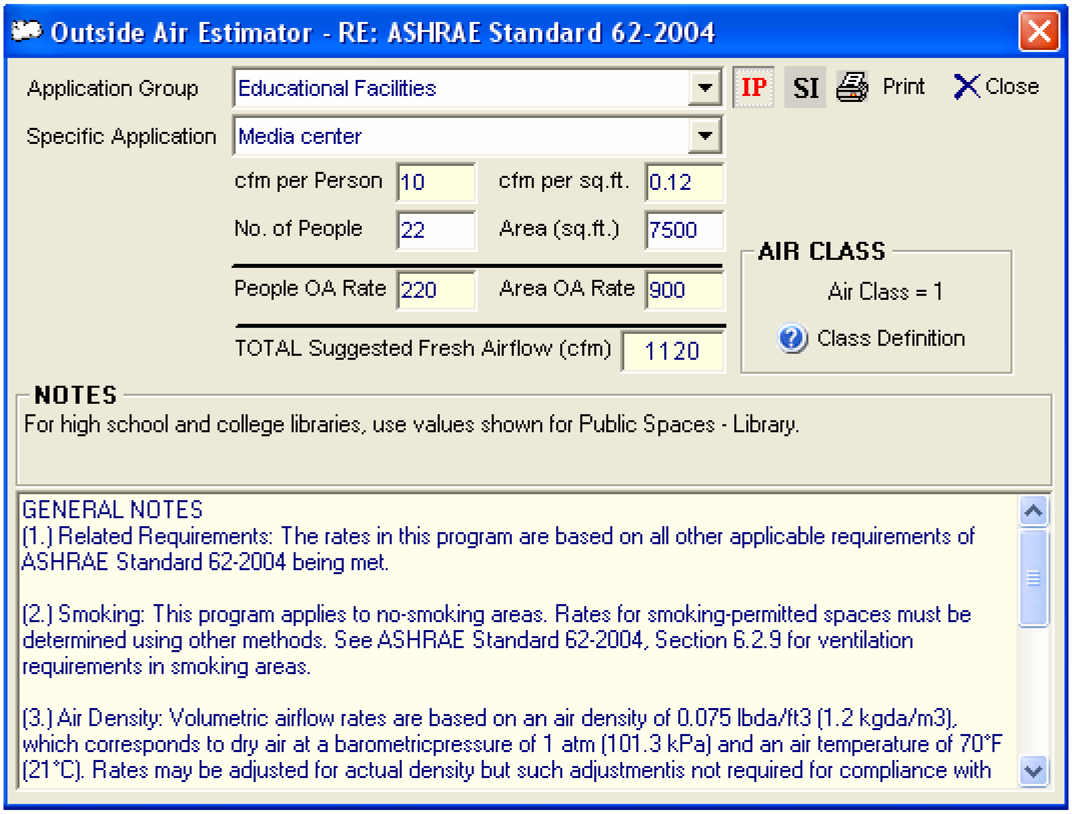
NEW export Data in EITHER *.txt format or *.csv format!!

Now you can export your psychrometric analysis data in either text file (*.txt) format or an Excel friendly comma delimited format (*.csv) for easy data exchange!!



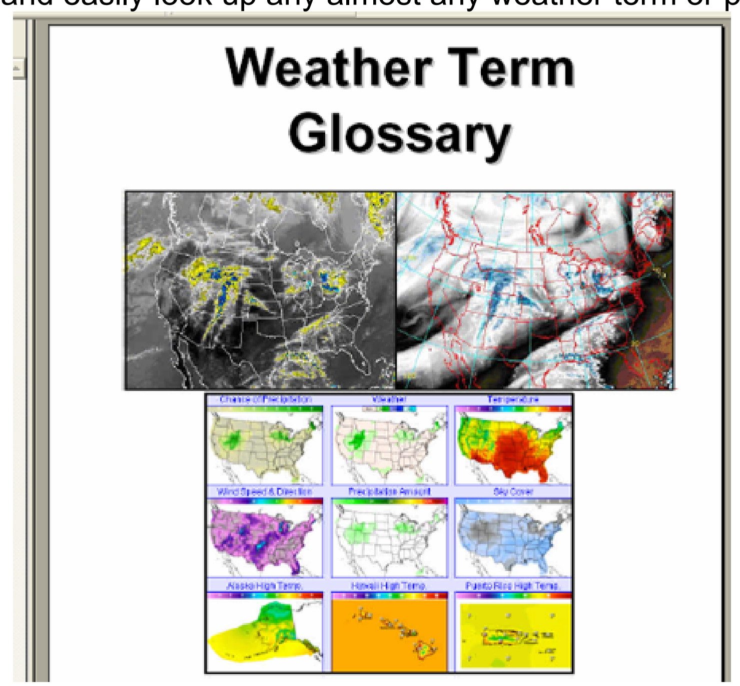
NEW Outdoor Air Estimator UPDATED to Standard 62-2004!!

Now you can quickly and easily obtain updated values from Table-16 from ASHRAE Standard 62-2004 with associated Notes and Air Classifications!!



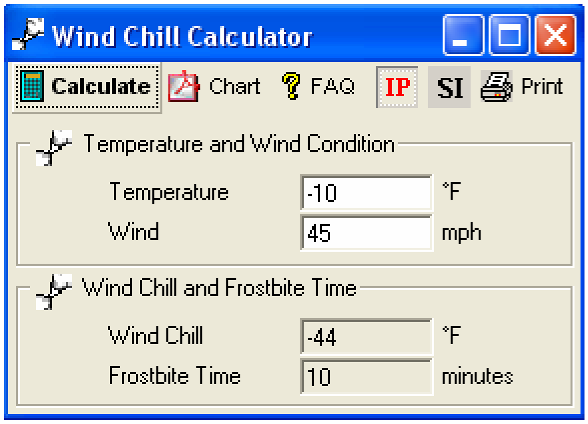
NEW Weather Term Glossary!!

Now you can quickly and easily look up any almost any weather term or phrase in seconds!!



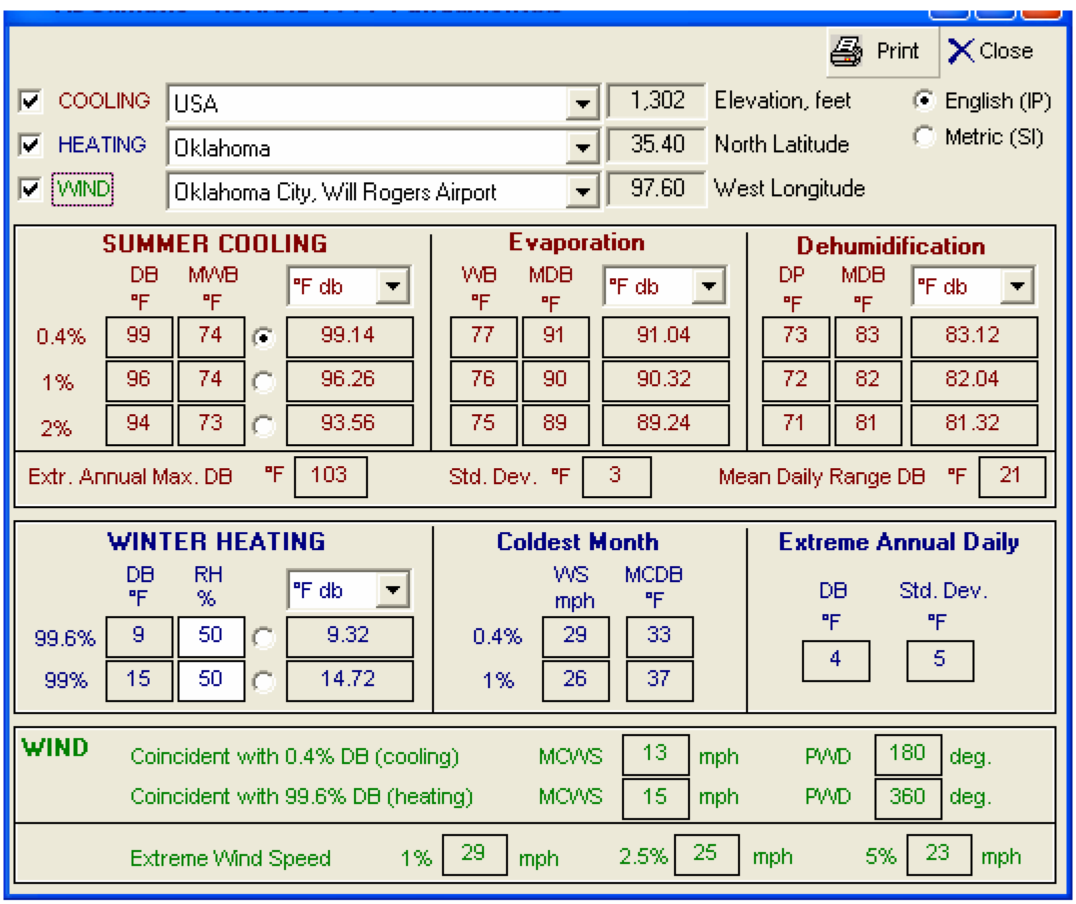
NEW Wind Chill Factor Calculator!!

Now you wind chill and frost bite times are at your fingertips and can be calculated in seconds!!



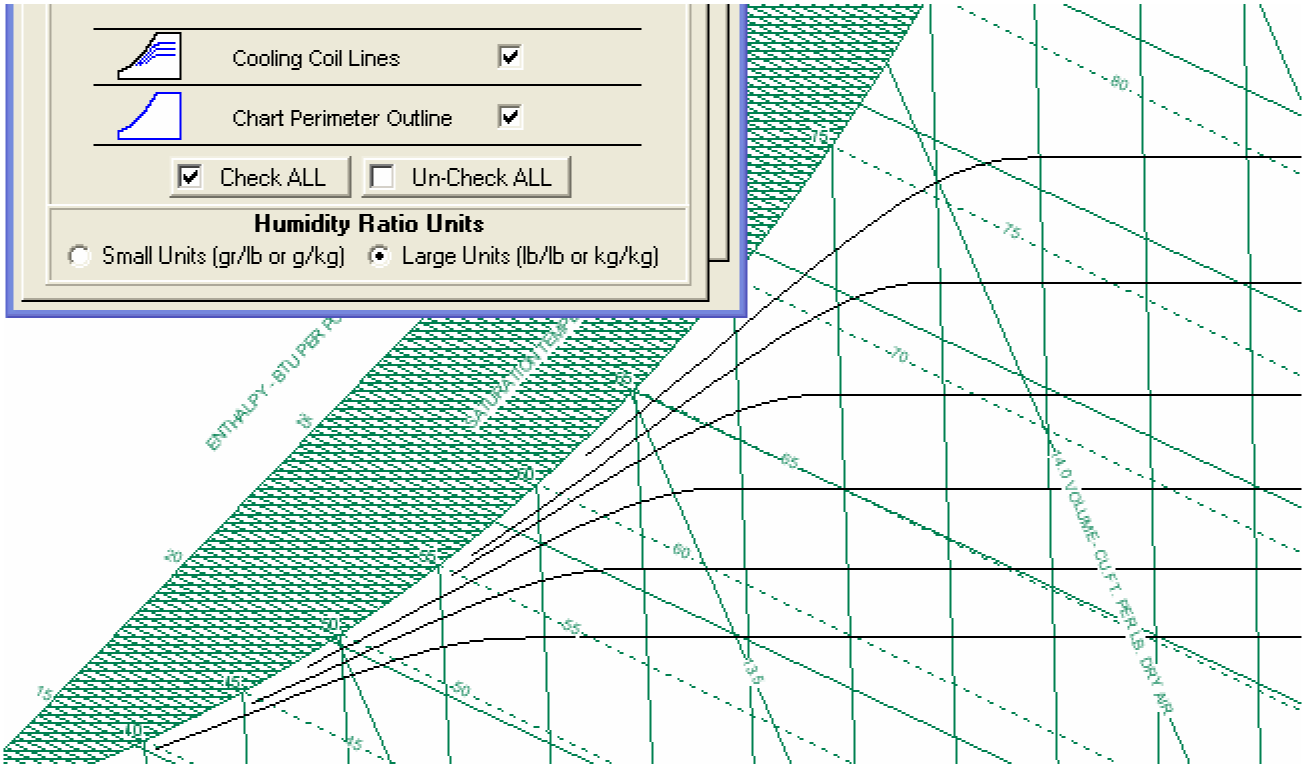
NEW Climatic Data PRINTING Capability Added!!

Instead of just viewing design data or adding it to your psychrometric system, now you can print all the design data for your location as well!!



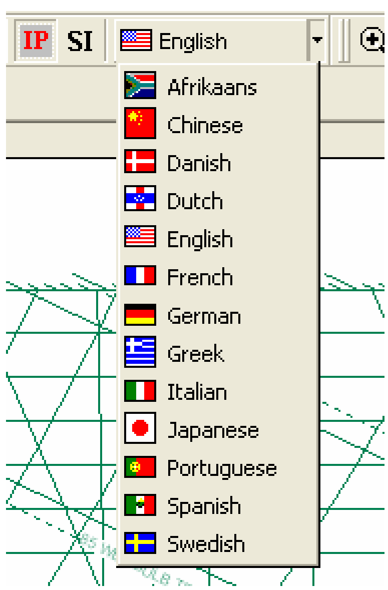
NEW Cooling Coil Performance Line Control!!

Now you can display cooling coil modeled curves right on the psychrometric chart!!



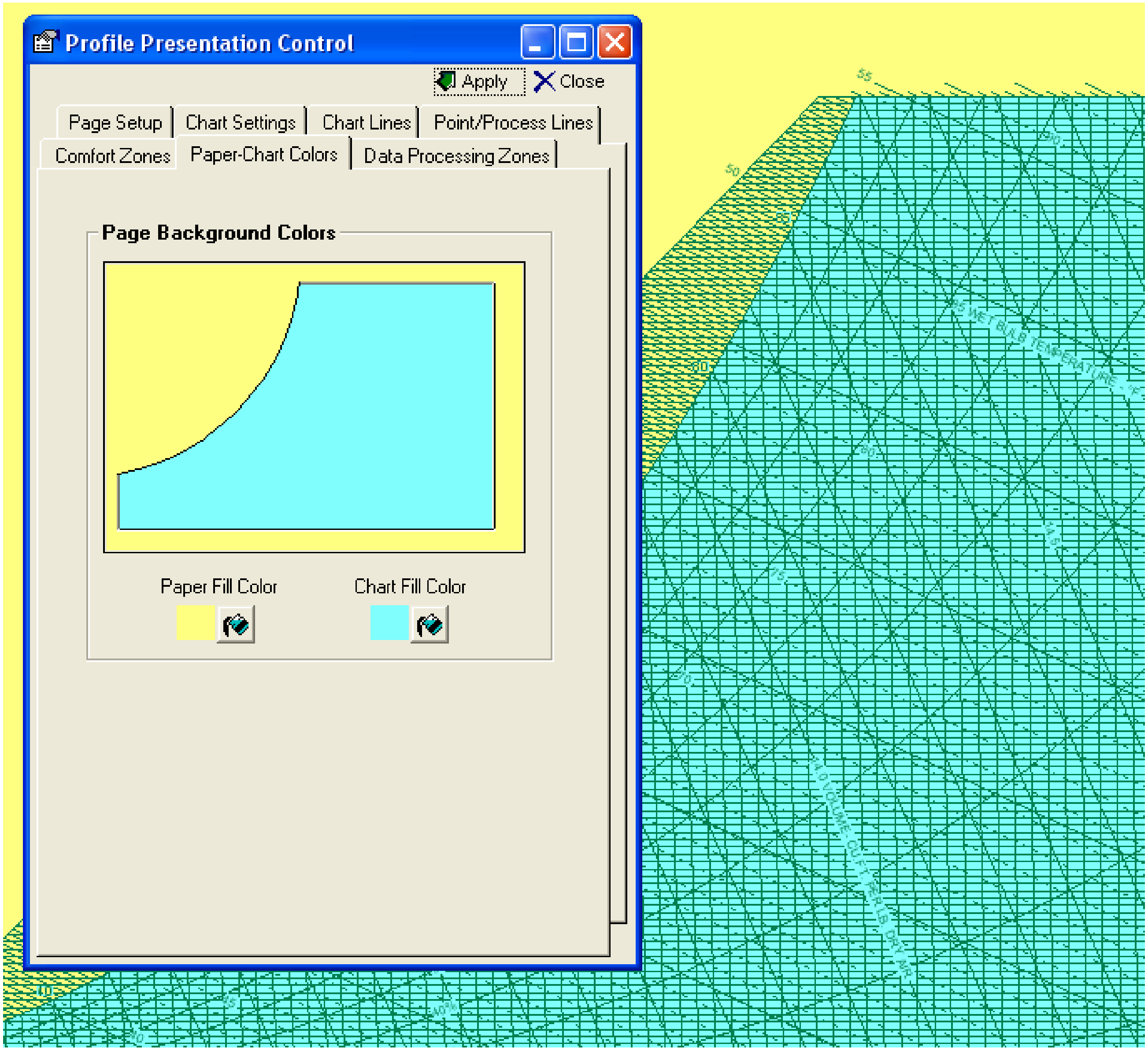
NEW Greek, Japanese and Dutch Languages Added!!

Now Psychrometric Analysis supports (13) Languages!!



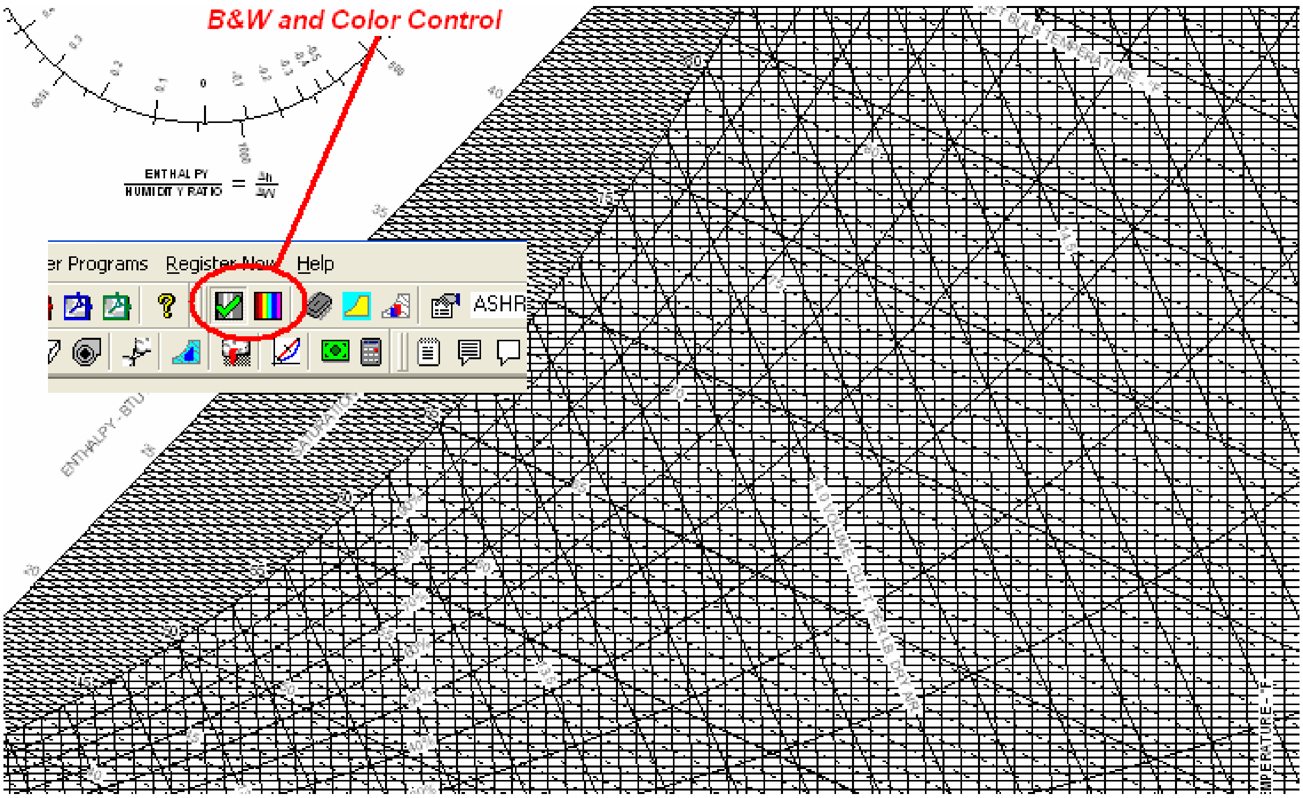
NEW Page and Chart Area Color Control!!

Now you can customize the appearance of the psychrometric chart and select virtually any color for the page and chart area!!



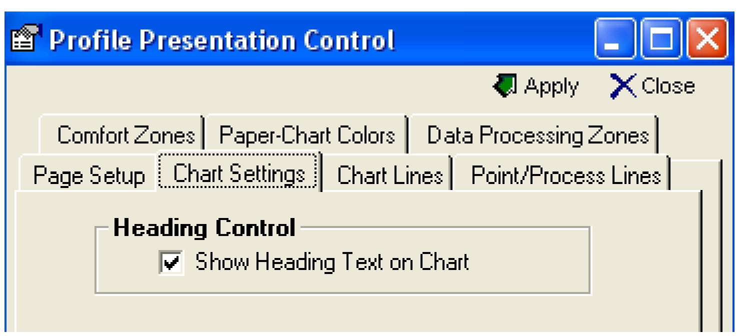
NEW Black & White <=> Color Display & Print Control!!

Now you can select Black and White only or Color display!!



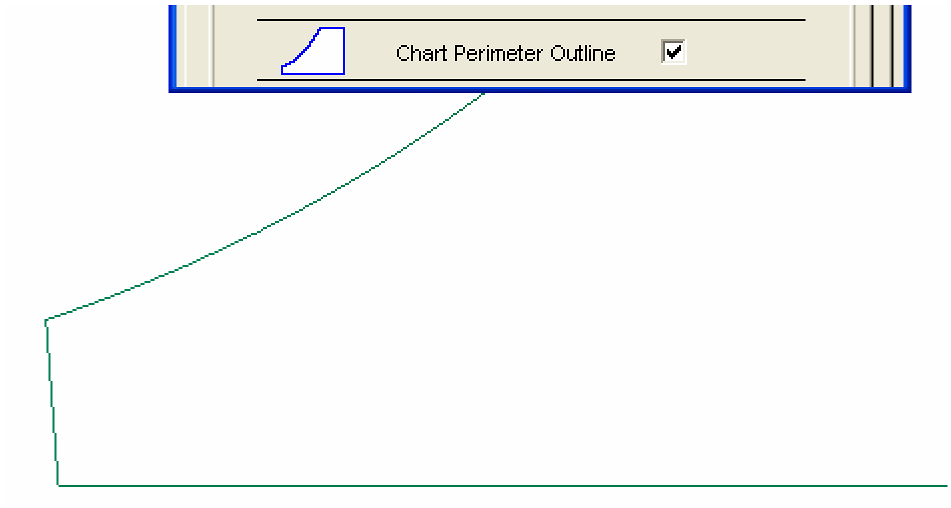
NEW Heading On/Off Control!!

Now you can turn Headings On or Off!!



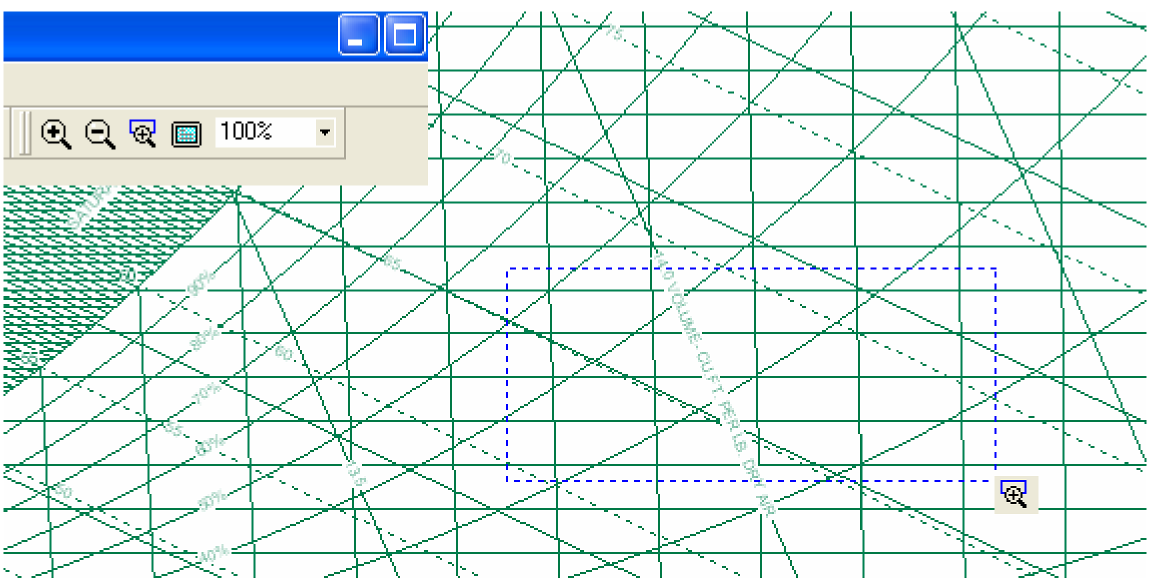
NEW Psychrometric Chart Outline Control!!

Now you can turn the Chart Outline On or Off!!

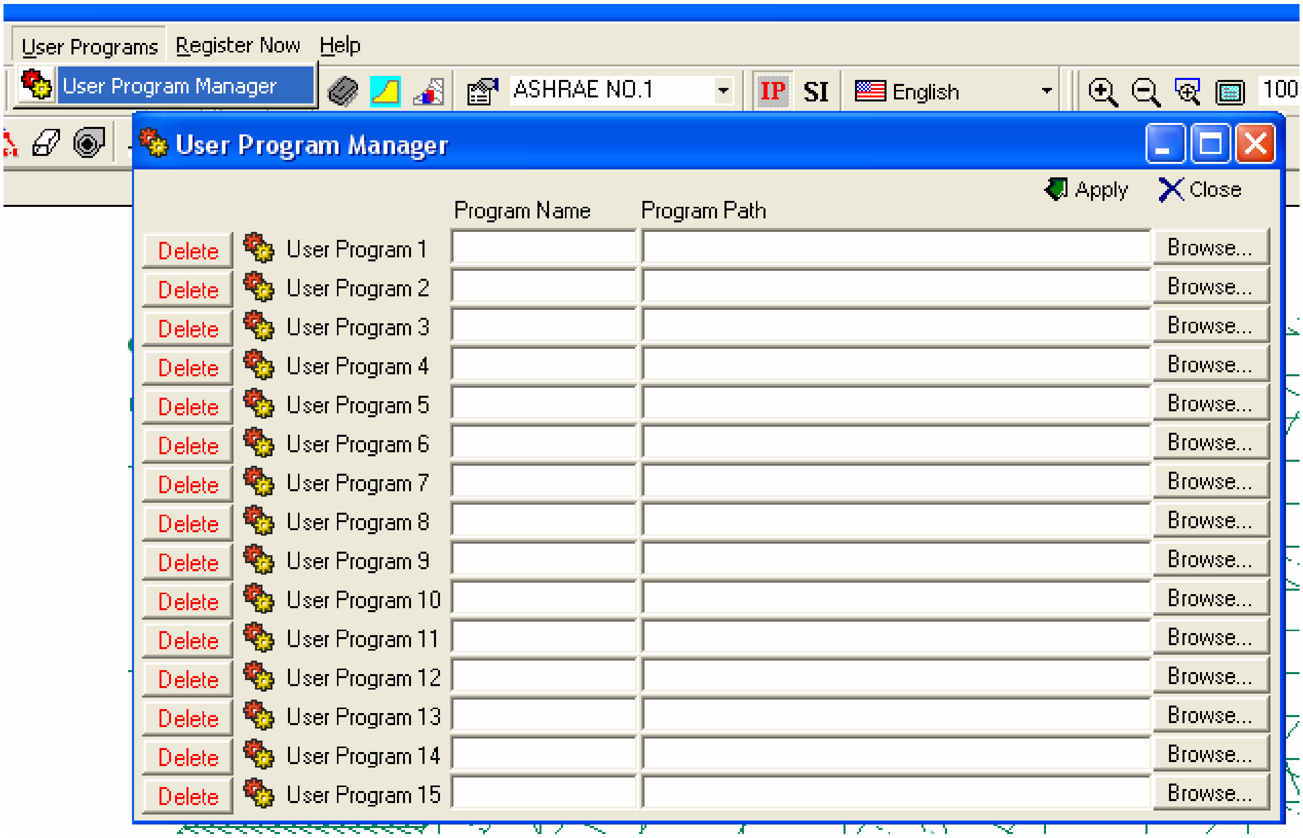


NEW Zoom Window Control!!

Now you can Zoom using a Window to specify where you want to Zoom!!

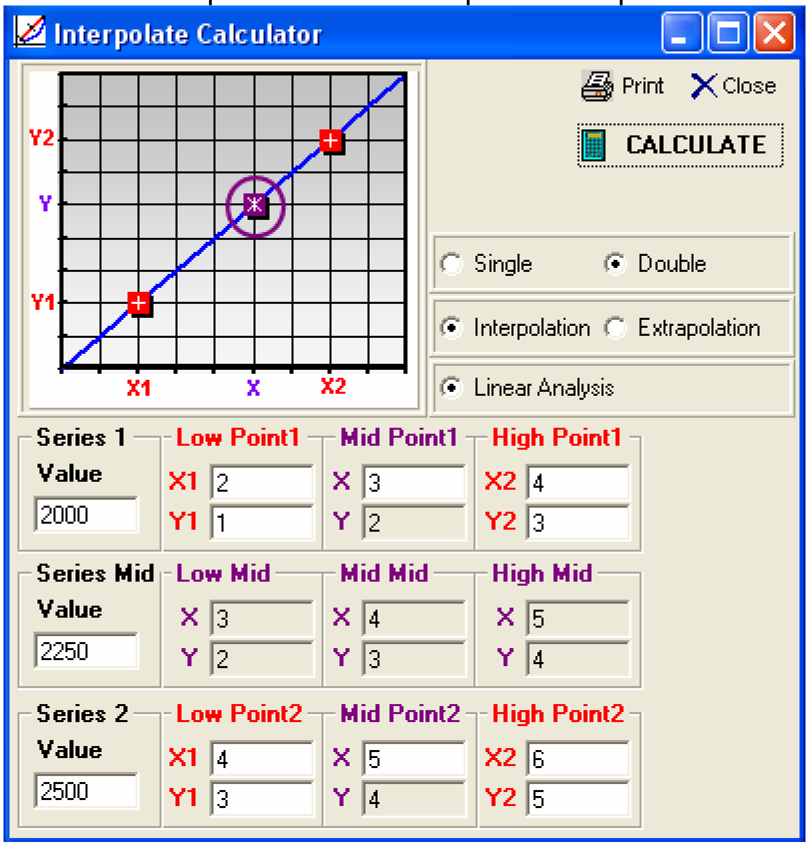


NEW Ability to add user defined "ToolBox" Programs under menu item tools!!
Now you can ADD your other Engineering Tools to the Psychrometric Analysis menu so you can access them easily and quickly!!



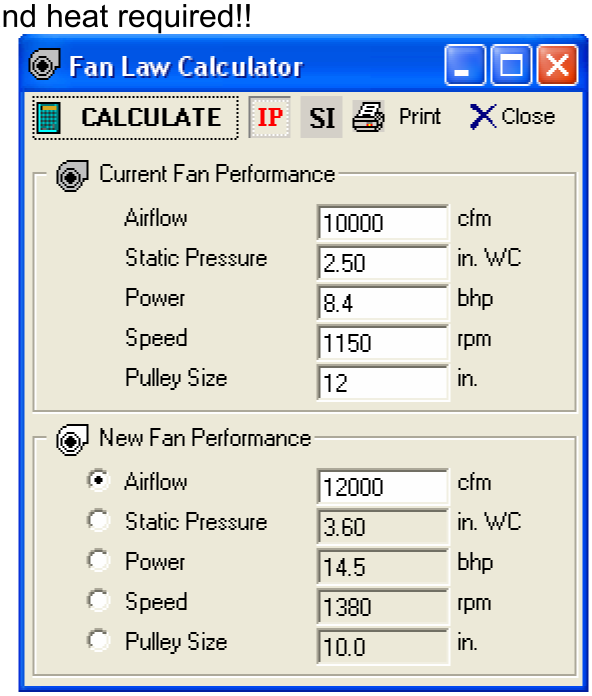
NEW Single & Double Interpolation and Extrapolation Calculator!!

Now single and even double Interpolation and Extrapolation is performed easily and quickly!!



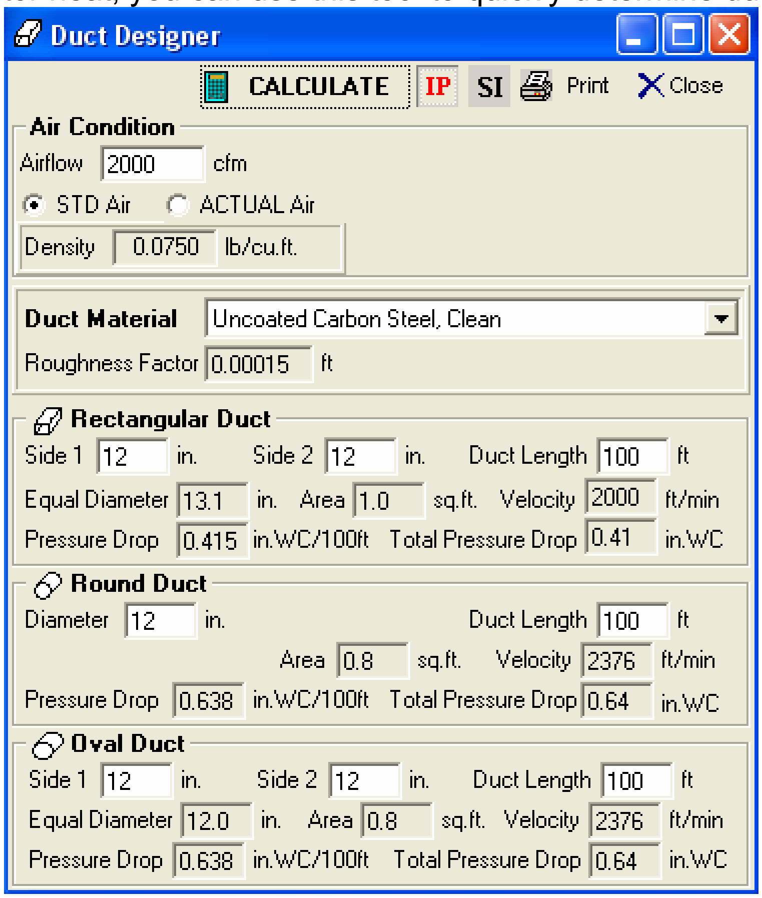
NEW Fan Law Calculator!!

Now when you're estimating fan motor heat for an unknown condition, you can quickly calculate the new power and heat required!!



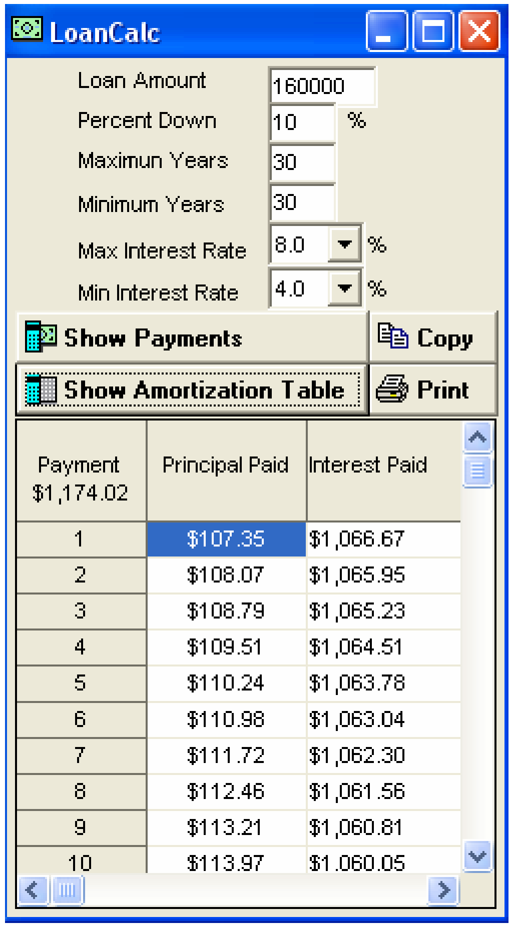
NEW Duct Sizing Calculator!!

Now when you need to estimate duct design static pressures for fan performance, required motor power and motor heat, you can use this tool to quickly determine duct pressure drops!!



NEW Financial Loan / Payment Calculator!!

Great for when you need to quickly estimate a payment or generate an amortization table!



PROGRAM FEATURES

OTHER PROFESSIONAL EDITION FEATURES!

Complete state point and process report with the ability to copy EITHER the report IMAGE or the DATA to the clipboard so you can paste it right into your proposals, presentations or the data into spreadsheets!!

STATE POINT & PROCESS REPORT

Report Date: Saturday, June 12, 2004
Project Information:
Altitude: 0 (Feet)
Barometric Pressure: 29.921 (in.Hg)
Atmospheric Pressure: 14.696 (psia)

Prepared By: Robert Hanna
Company: Hands Down Software
Phone: (405) 844-6314
Fax: (405) 844-6314
email: sales@handsdownsoftware.com

1. RA

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	75.000	63.940	55.0	0.01022	13.695	29.181	57.7592	0.0729	0.4817	5.222

2. DH

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	90.000	63.940	22.6	0.00678	14.003	29.067	46.7887	0.0713	0.3215	3.390

Process: Desiccant Dehumidification

Start Point Name	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Dehumid-ification (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)	Sensible Energy Per Dehumidification (Btu/lb)
RA	-514	16,403	-16,917	-15.5	-31.912	33	-1,061.1

3. SC

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	65.000	60.449	77.4	0.01022	13.439	26.735	57.7592	0.0743	0.4817	5.322

Process: Sensible Cooling

Start Point Name	Total Cooling (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Moisture Difference (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	-0.9	-11,005	-11,005	0	0.0	1.000	N/A

4. SH

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	90.000	68.746	33.8	0.01022	14.079	32.849	57.7592	0.0710	0.4817	5.080

Process: Sensible Heating

Start Point Name	Total Heating (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Moisture Difference (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	1.4	16,506	16,506	0	0.0	1.000	N/A

5. CC

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	55.000	54.800	98.8	0.00912	13.160	23.097	54.6642	0.0759	0.4306	4.850

Process: Cooling Coil

Start Point Name	Total Cooling (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Dehumidification (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	-2.3	-27,379	-21,965	-5,414	-4.9	0.802	5,533

6. EC

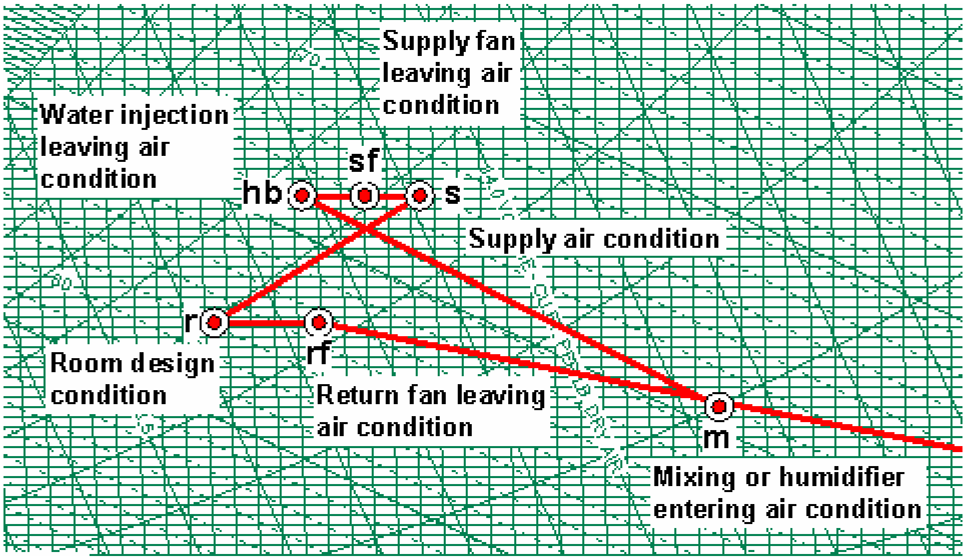
STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	65.000	63.940	94.5	0.01253	13.488	29.256	63.3962	0.0741	0.5885	6.503

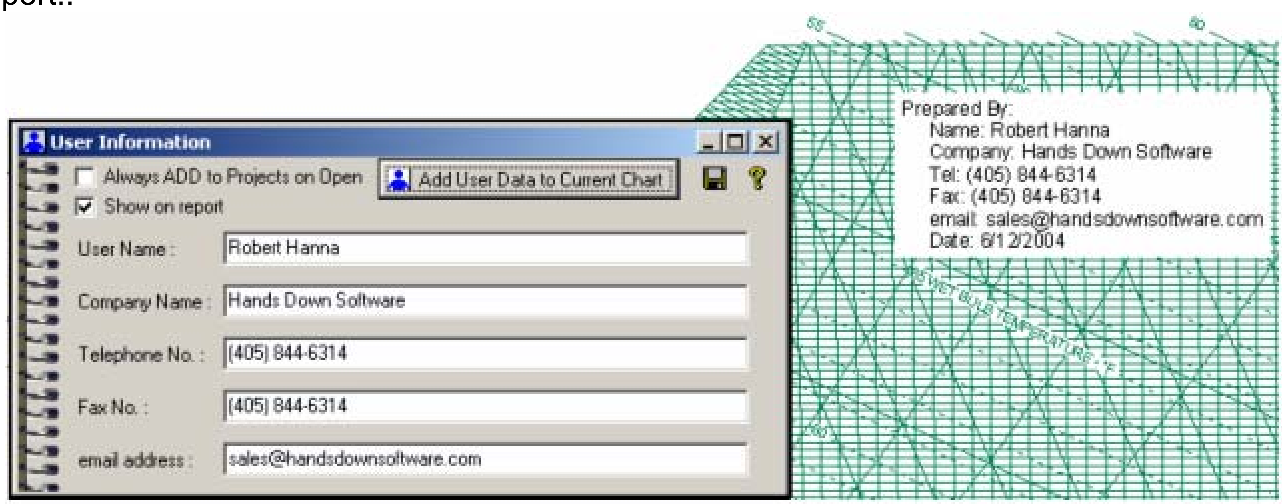
Process: Evaporative Cooling

Version 5.0.0 Page 1

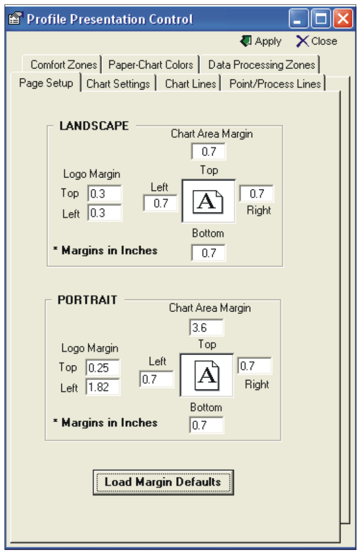
Complete project information and note capabilities!! Notes are individually controlled allowing for font, color, border, background, etc to all be specific to each note. Complete Drag-n-drop functionality as well as new-edit-delete note management!!

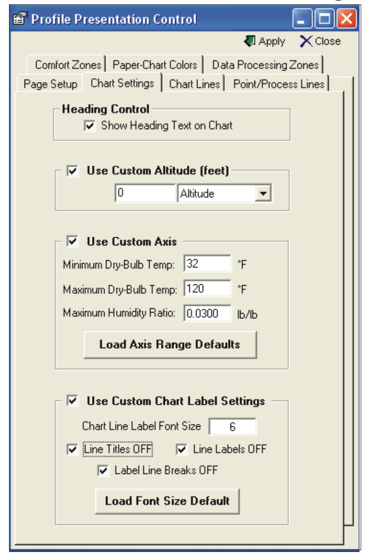


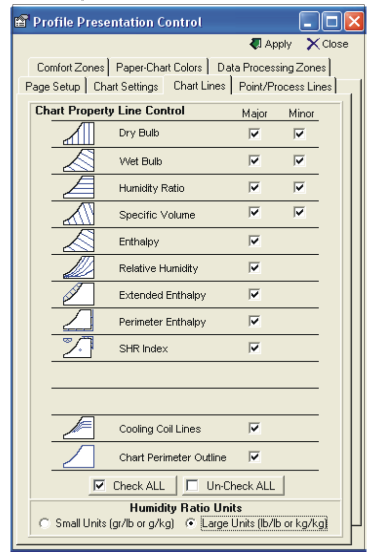
User information and auto note display capability!! User information is added only once and is automatically available for displaying on both the chart and/or the state point and process report!!

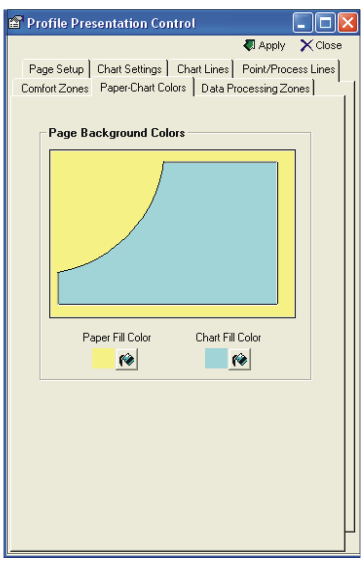


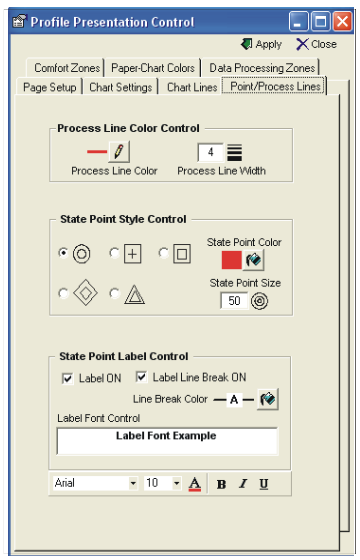
Complete Chart control including virtually any Altitude or Pressure, Dry-Bulb and Humidity Ratio Axis Limit Control, turning Lines ON & OFF, Process line color and width, state point icon and size, state point label font control, Comfort & Data Center Zones, Page Setup and more!!

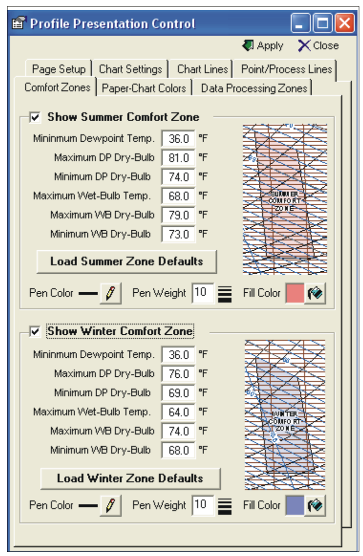


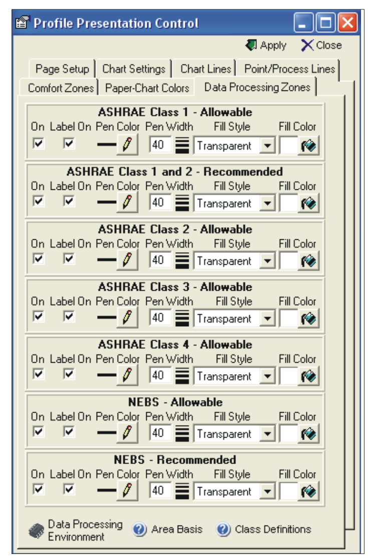




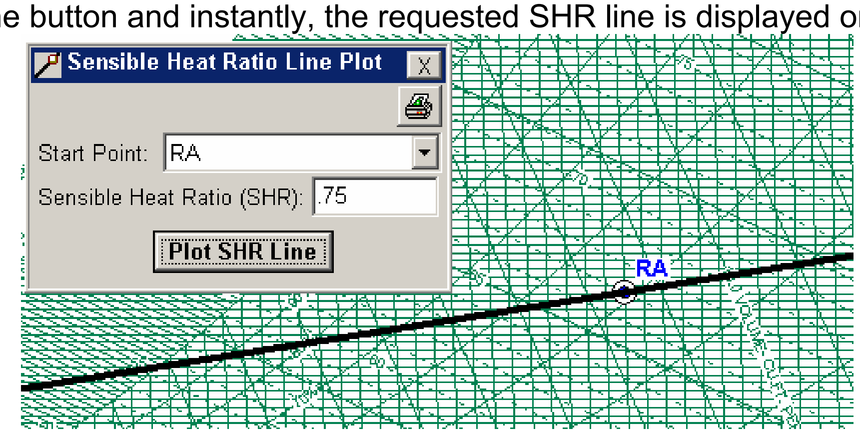




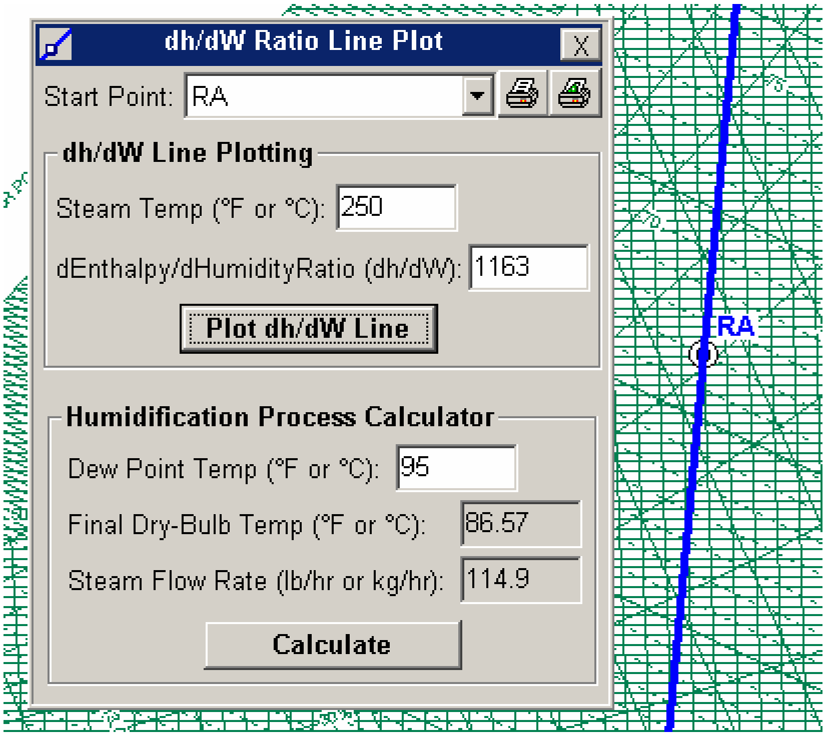




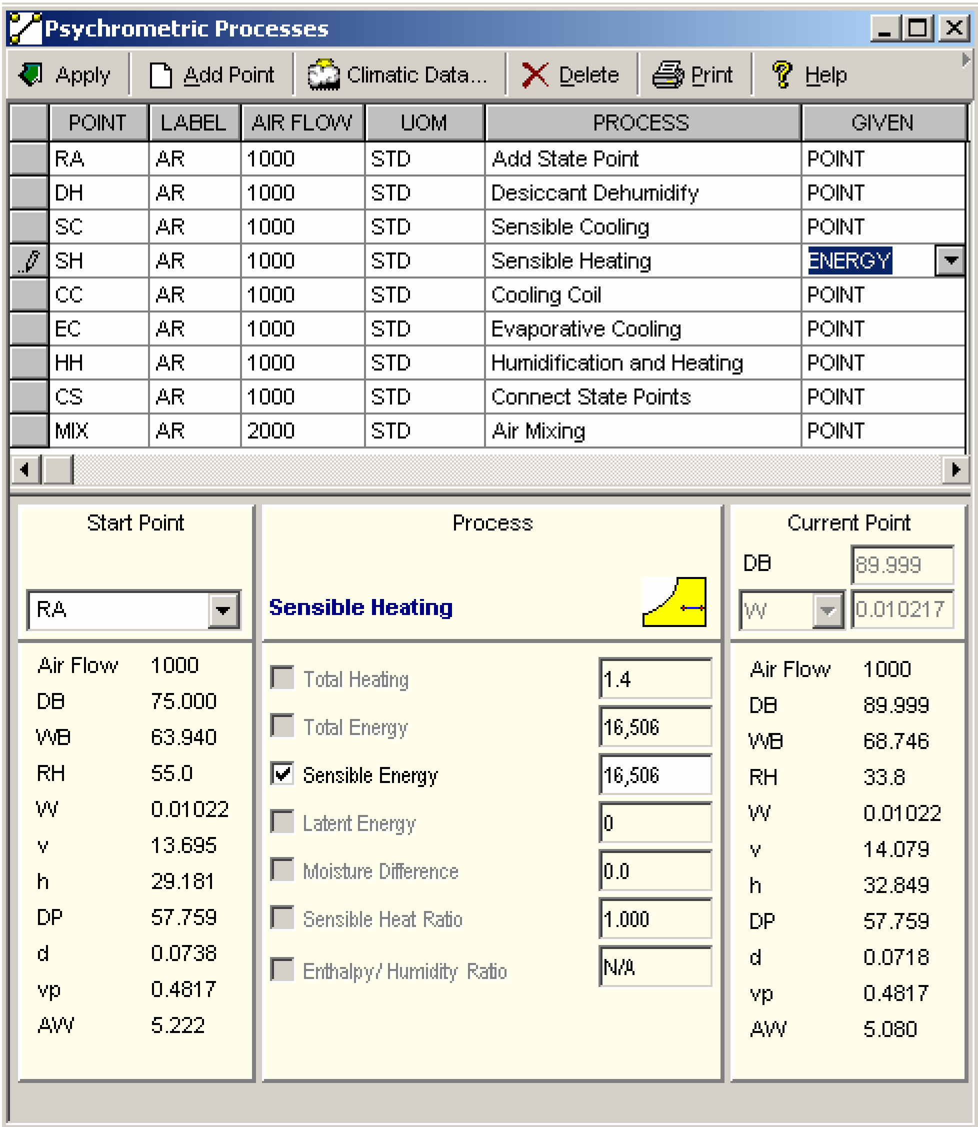
Sensible Heat Ratio Line Plotting is available with one simple button click!! Type the desired SHR and click the button and instantly, the requested SHR line is displayed on the chart!!



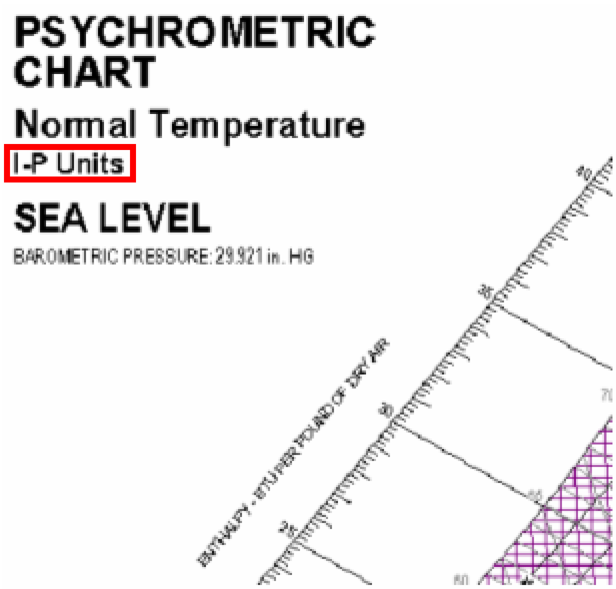
Humidification Delta-Enthalpy / Delta-Humidity Ratio Line Plotting is available with one simple button click!! Steam Flow rate is automatically calculated based on desired Final Dew Point Temperature!!

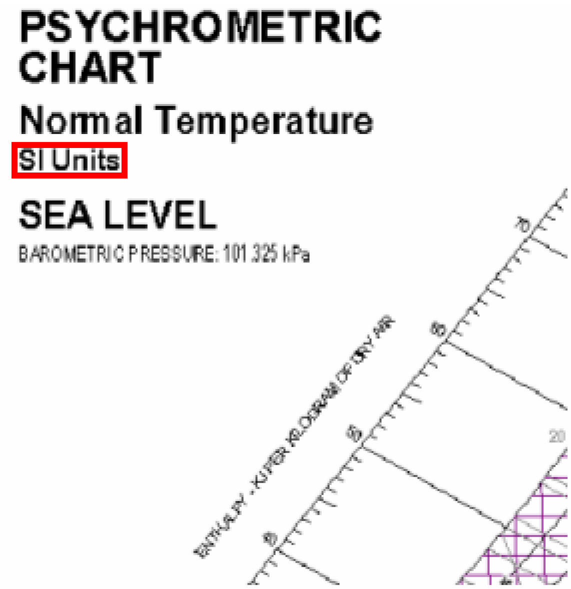


Complete State-Point and System Process Analysis capable. Process modeling includes AIR MIXING, COOLING COIL, EVAPORATIVE COOLING, DESICCANT DEHUMIDIFICATION, HUMIDIFICATION and SENSIBLE HEATING & COOLING!! All processes can either have END POINT specified, CALCULATING PROCESS DATA or PROCESS DATA specified, CALCULATING END POINT result!

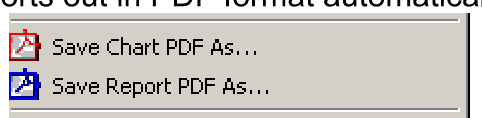


All Charts, state-points and process data are converted automatically between **IP and/or SI** with the click of a button!!

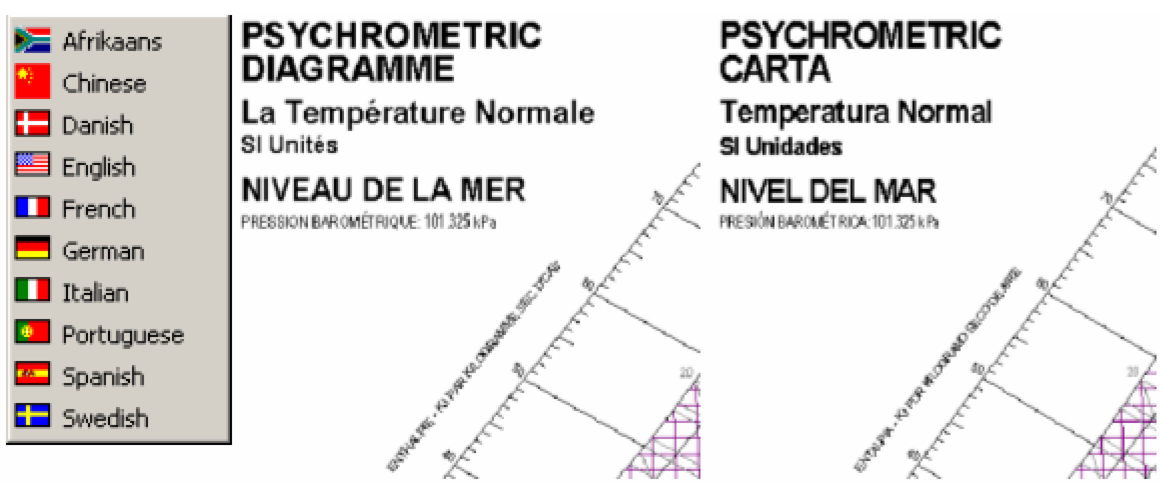




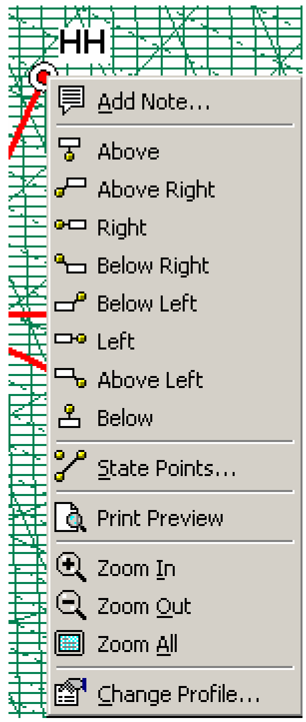
Ability to export chart and reports out in PDF format automatically!!



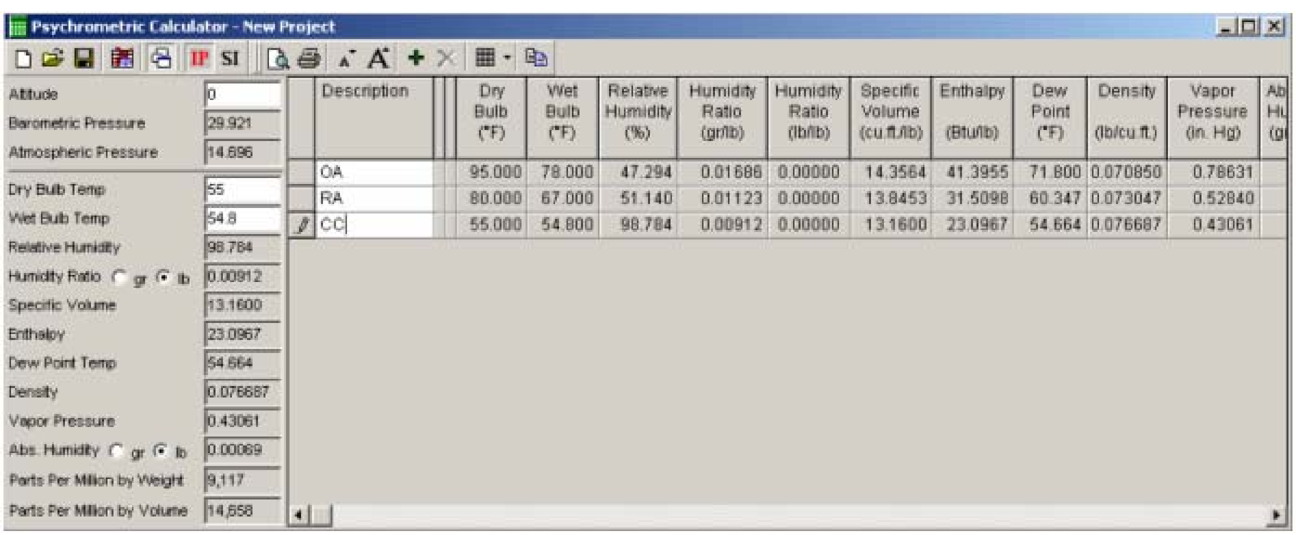
Automatically convert between **(10) different Languages** just by Clicking a button!!



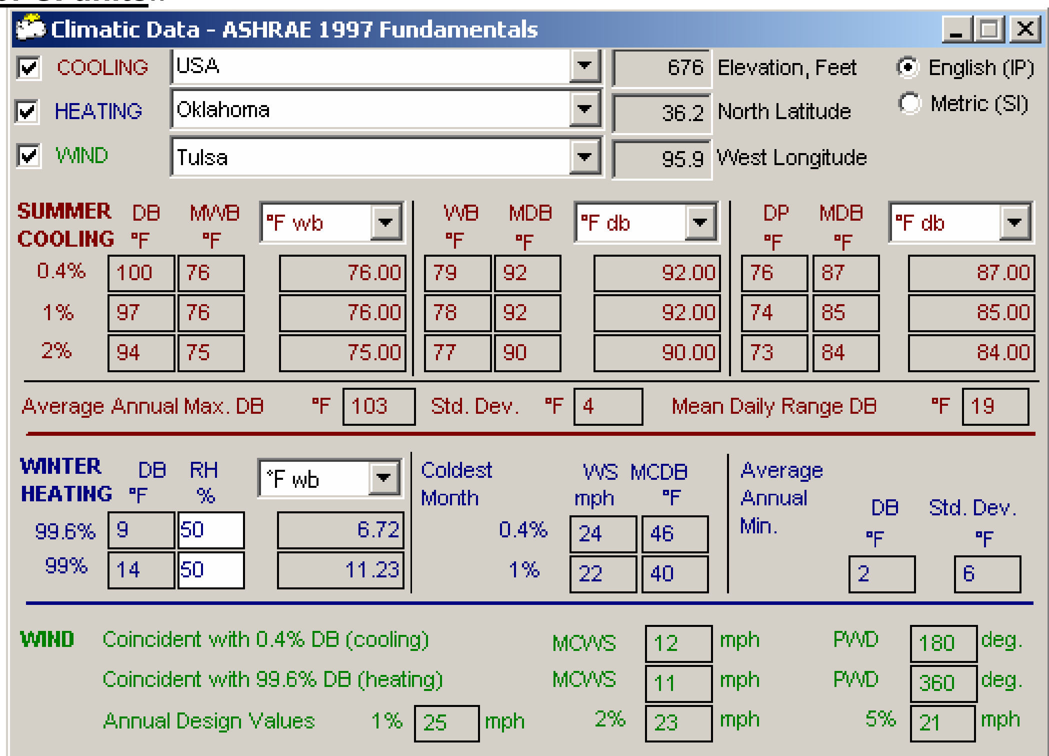
Right-Click Pop-Up menus allow for easy control of the chart whether it's moving state-point labels or managing chart notes!! Left Double-Click automatically ZOOMS-IN and Right Double-Click automatically ZOOMS-OUT. Hold the left buttom down and Drag allows you FULL PANNING of the chart!!



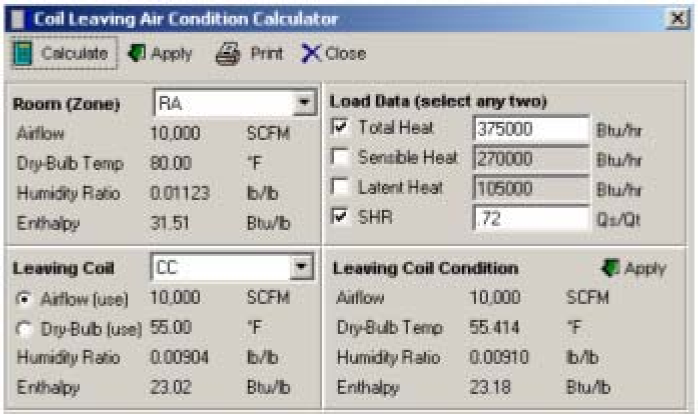
Complete Psychrometric Calculator with File-Open-Save capabilities and outputs in either IP or SI units!!

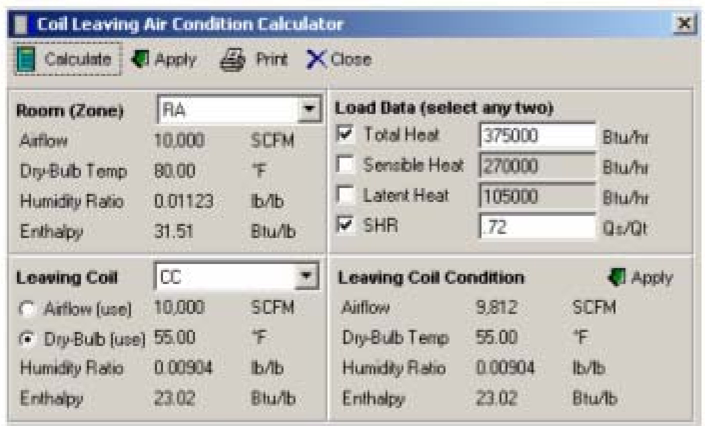


Complete Climatic Outside Air Design Data for over 1,000 cities throughout the WORLD for **<u>either IP or SI units</u>**!!

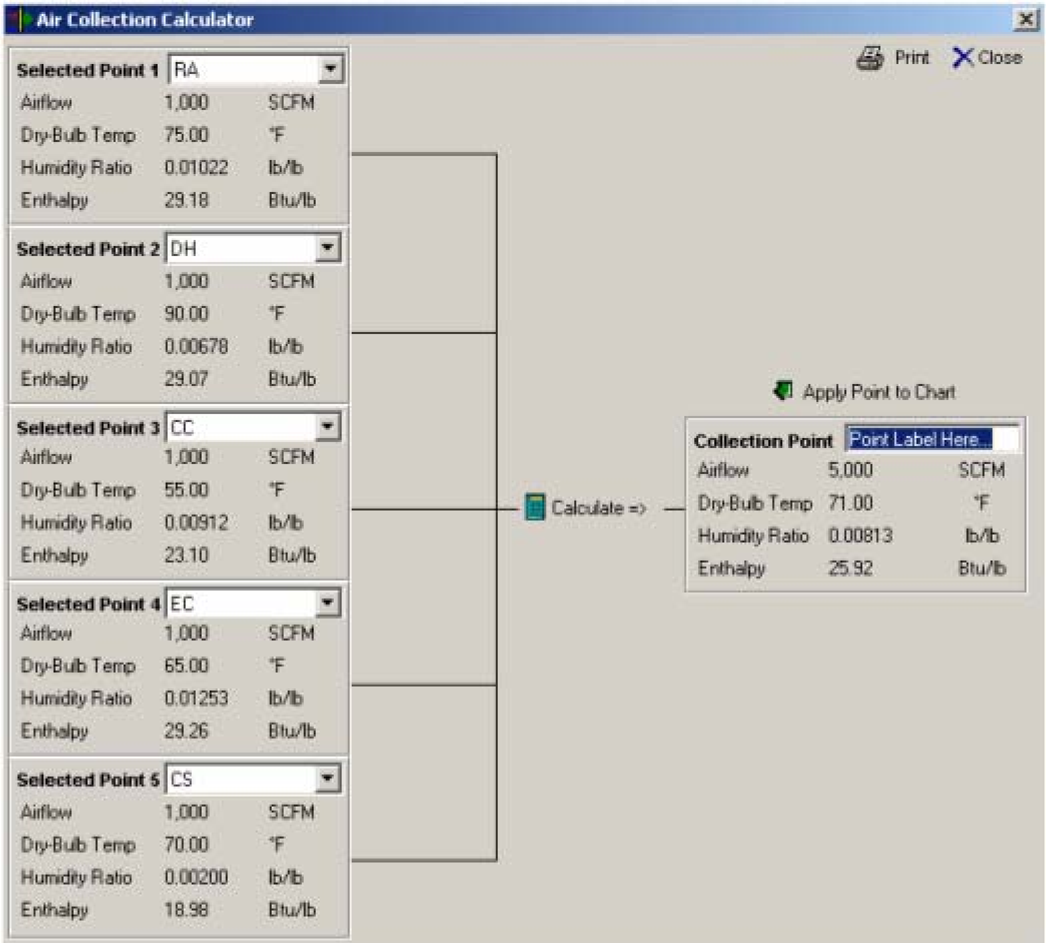


Complete Cooling Coil Leaving air condition calculator!!! Automatically calculate the Leaving air temperature or the airflow for cooling coils!!

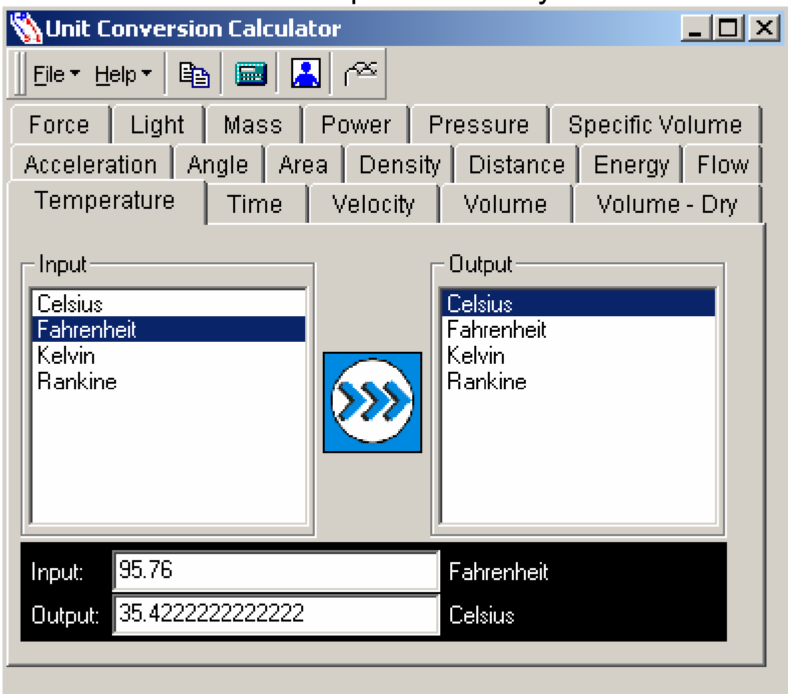




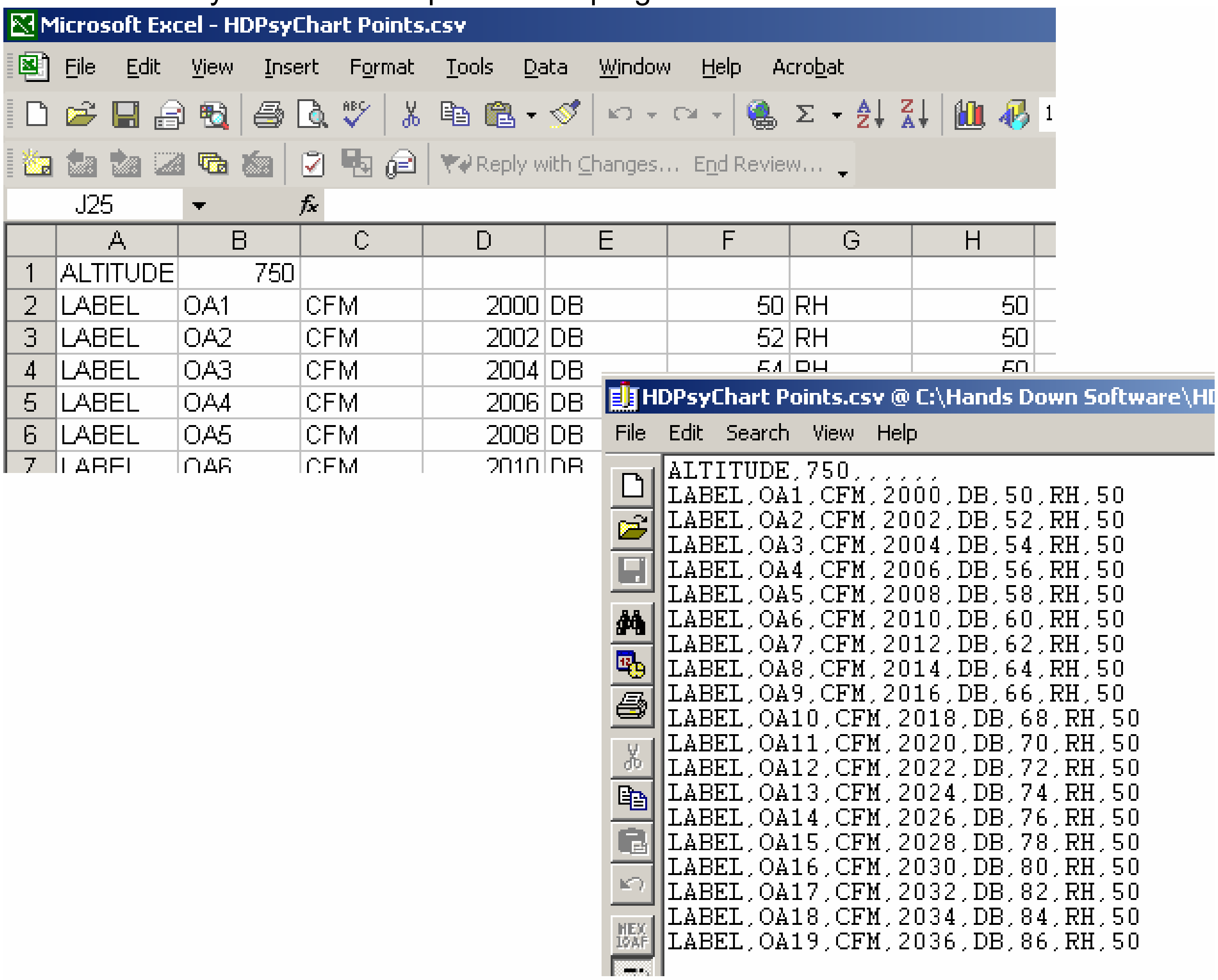
Integral Air Collection Calculator!! Simply click on the combo box drop downs and select the state points desired for collection, and with one “Calculate =>’ button click, your system collection point is automatically displayed, available to be added to your system, chart and report!!

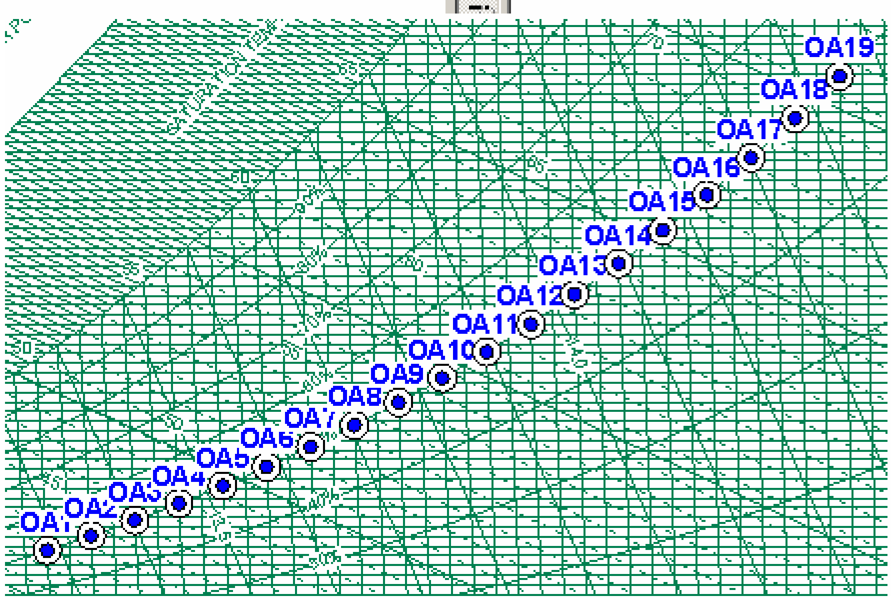


Complete unit of conversion calculator for quick and easy IP<>SI unit conversions!!

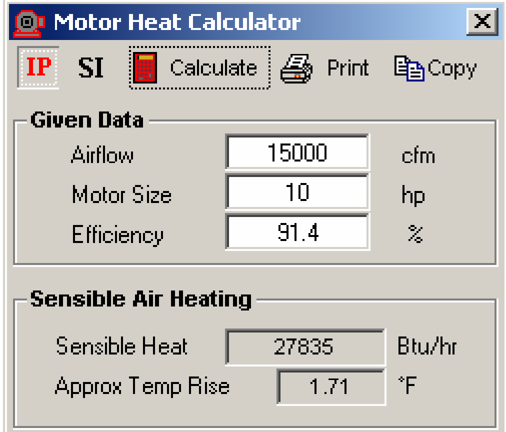


Complete Data Exchange Capabilities!! You can export data, charts and reports either by Edit-Copy copying to the clip board, or by automatically exporting out to a PDF file!!
Importing of Data is accomplished with comma delimited ".csv" files which can easily be generated with any text editor or spreadsheet program such as Microsoft Excel!!!

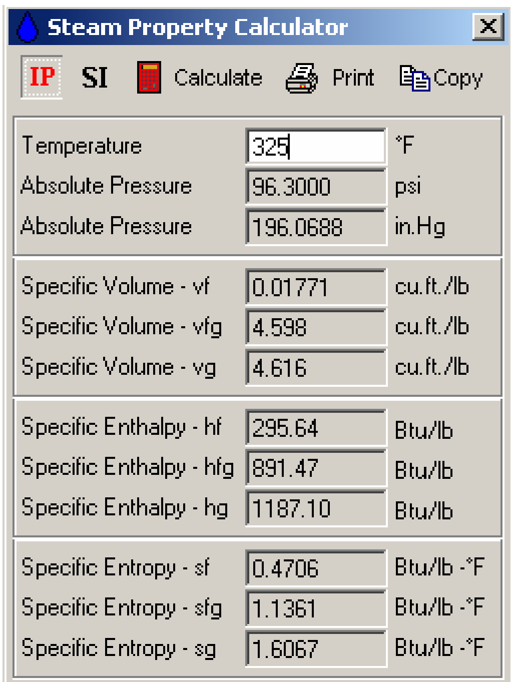




Motor heat calculation is one button click away!! Simply type in the motor size (power) and the efficiency and instantly get the resulting sensible heat generated by the motor along with the corresponding temperature rise!!



Complete Steam Property Calculator in both IP and SI units of measure!!!



VERSION AND RELEASE HISTORY

VERSION 6 – NEW FEATURES (Release Jan-2007)

NEW PROCESS ANALYSIS CAPABILITIES
- ***New Auto Flow Chart Diagram***
- ***New Individual Process Line Color Control***
- ***New Individual Point Color, Shape and Size Control***
- ***New Winter "V" Air Mixing Capability with Condensation***
- ***New Fog Region Property Display***
- ***Constant h, WB, HR, DB Line Control***

NEW TOOLS
- ***New Complete Thermal Comfort Calculator***
- ***New Weather Data Plotting with Complete Global Weather Files***
- ***New Weather Bin Shade Plotting with Complete Control***
- ***New Global Weather Data Table Access***
- ***New Weather Term Glossary***
- ***New Wind Chill Factor Calculator***
- ***New Climatic Data Printing Capability Added***
- ***New Outside Air Estimator UPDATED to ASHRAE Standard 62-2004***

NEW PRESENTATION CONTROL
- ***New Humidity Ratio Unit of Measure Control***
- ***New Mouse Cross-Hair (Like CAD!!) or Target Control***
- ***New Cooling Coil Performance Line Control***
- ***New Page Color Control***
- ***New Chart Area Color Control***
- ***New ASHRAE Class 1 through 4 Datacenter Zones (allowed & recommended)***
- ***New NEBS Datacenter Zones (allowed & recommended)***
- ***New Black & White <=> Color Display & Print Control***
- ***New Heading On/Off Control***
- ***New Outline On/Off Control***
- ***New Zoom Window Control***

NEW TOOLBOX ANALYSIS
- ***New Ability to add user defined "ToolBox" Programs under menu item tools***
- ***New Single & Double Interpolation Calculator***
- ***New Fan Law Calculator***
- ***New Duct Sizing Calculator***
- ***New Loan Calculator***

NEW ADDITIONAL CAPABILITIES
- ***New High Pressure Capability up to 100 PSI***
- ***New Auto-Altitude Change with Climatic Location Selection***
- ***New Fog Region Thermo-Physical Property Display***

NEW LANGUAGES
- ***Now with (13) Different Languages on Charts and Reports with one button click***
- ***New Greek Language***

- New Japanese Language
- New Dutch Language
- Improved Italian Language Updated
NEW DATA EXCHANGE
- New REAL-TIME Data Monitoring Capability
- New Process Control added to Data Import Function
- New Complete Weather Data Export to Excel or Text File
- SI units added to text file & Excel Data Exchange
- New Export-As Excel *.csv File
- New Export-As Notepad *.txt File
NEW NOTES
- Improved Note Control Update

VERSION 5 – FEATURES (Release Jan-2005)

NEW PRESENTATION CONTROL
- New Custom Axis Range Control
- New Chart Altitude or Pressure Control
- New Lines ON/OFF Control
- New Process Line Color & Width Control
- New State Point Icon, Size Control, Color & Label Control
- New Comfort Zone Area Plotting
- New User information Saved/Displayed on Charts & Reports
- New Page Setup Control
NEW PROCESS ANALYSIS CAPABILITIES
- New Sensible Heat Ratio Line Plotting
- New Humidification Delta-Enthalpy / Delta-Humidity Ratio Line Plotting
- New Partial Mixing of Airstreams Allows for Component Mixing Bypass
- New Cooling Coil Leaving Air Calculator / Auto-Plotting
- New Organized Toolbar Menu Setup
NEW TOOLS
- New Air Collection Calculator with Auto-Plotting
- New Integral IP<=>SI Unit of Measure Calculator
- New Fresh Air Estimator Updated to 62-2001
- New Motor Heat Calculator
- New Steam Property Calculator
NEW ADDITIONAL CAPABILITIES
- New Easy Auto-Create / Export PDF Files of Charts & Reports
NEW LANGUAGES
- Now (10) Languages including CHINESE
NEW DATA EXCHANGE
- New Complete Data Exchange Capabilities
NEW NOTES
- New Add/Edit/Delete Note Control with Drag-Drop Positioning
- New Project Information Control Displayed on Chart & Report

VERSION 4 – FEATURES (Release Jan-2003)

NEW PRESENTATION CONTROL
- ***New State Point and Process Report***
- ***New Universal IP <=> SI Unit Control***

NEW PROCESS ANALYSIS CAPABILITIES
- ***New Air Mixing Process***
- ***New Cooling Coil Process (with REAL Cooling Coil Curves!)***
- ***New Desiccant Dehumidification Process***
- ***New Sensible Heating Process***
- ***New Heating & Humidification Process***
- ***New Evaporative Cooling Process***
- ***New Sensible Only Cooling Process***

NEW TOOLS
- ***New Stand Alone Psychrometric Calculator***
- ***New Stand Alone World-Wide Climatic Data***
- ***New Stand Alone Outside Air Calculator based on ASHRAE Standard 62-89***

NEW ADDITIONAL CAPABILITIES
- ***New State Point Label Positioning Control***
- ***New Zoom & Pan Control***
- ***New Mouse-Move Thermo-Physical Property Display***

NEW LANGUAGES
- ***New (7) Different Languages on Charts & Reports with one-button click***

NEW DATA EXCHANGE
- ***New Ability to Copy Chart to Clipboard***
- ***New Ability to Copy Report to Clipboard***

PROGRAM SUPPORT

Technical Support

Technical support is **free of charge** and available by fax, mail, email and through our World Wide Web site.
It is our policy to respond to all inquires within 48 hours from receipt.
Please include Version number found in the “About” box under the Help menu with your inquiry.

Email: support@handsdownsoftware.com
Phone: 405.844.6314
Fax: 405.844.6314
Write: Hands Down Software
1108 Olde Bridge Road
Edmond, OK 73034
USA
Web: http://www.handsdownsoftware.com

Contact Us

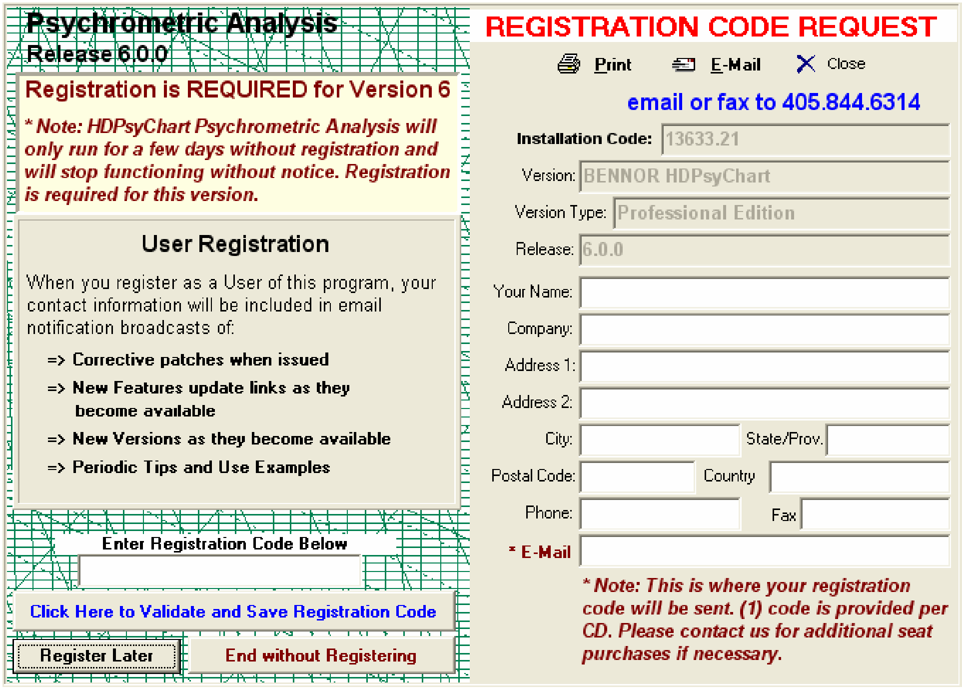
HANDS DOWN SOFTWARE
1108 Olde Bridge Road
Edmond, OK 73034
USA
Off: 405.844.6314
Fax: 405.844.6314
Email: info@handsdownsoftware.com

OFFICE HOURS
8:00 am - 5:00 pm Central Standard Time
Monday through Friday

HOLIDAYS
New Year's Day
Memorial Day
July 4th
Labor Day
Thanksgiving
Christmas

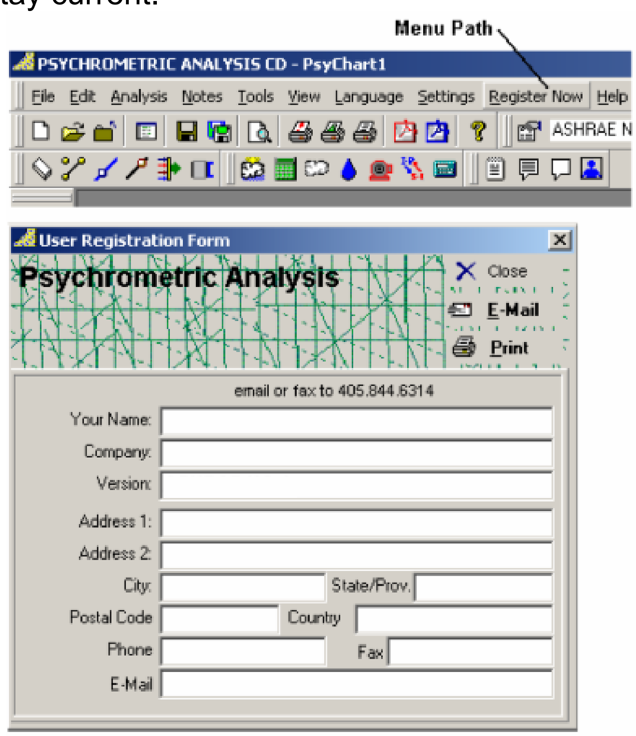
V6 Registration

Version 6 requires a registration code for EACH Seat, (1) Seat is licensed per CD, unless you have purchased a site license.



General Registration

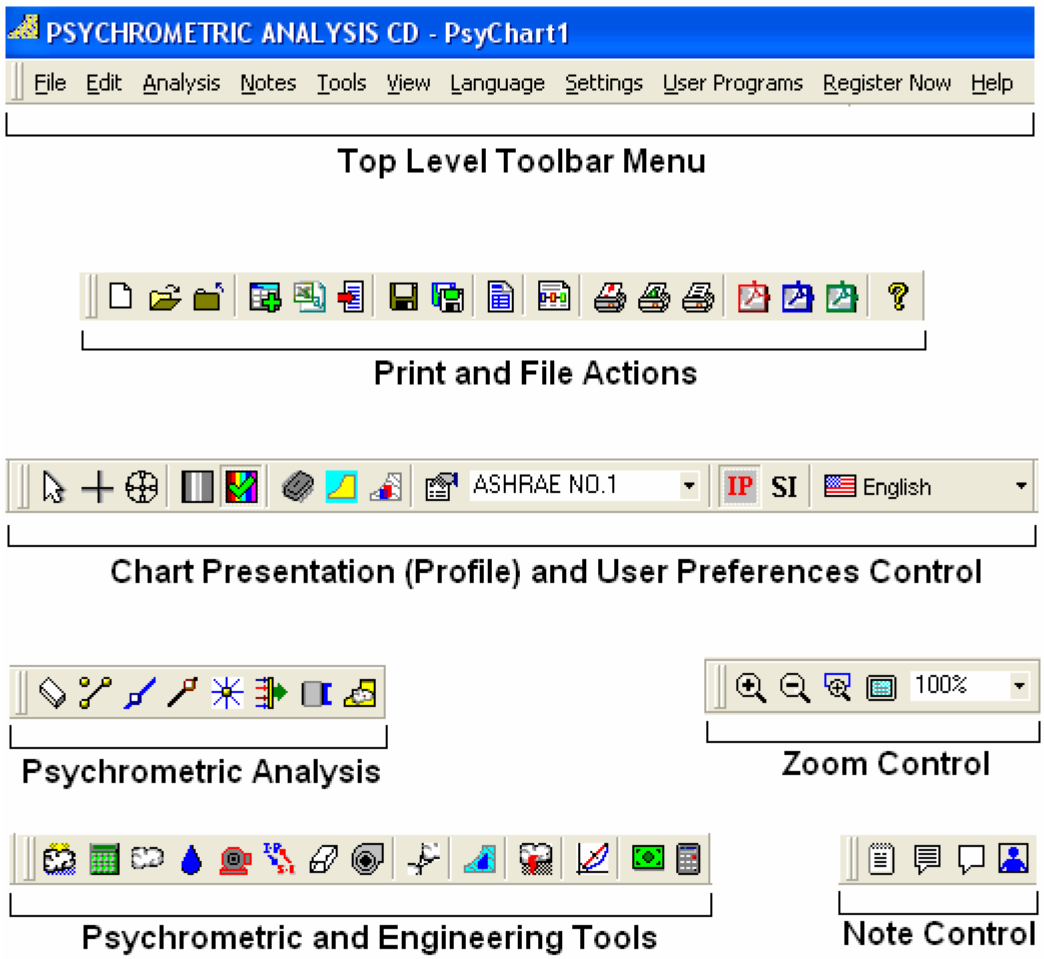
When you register as a User of this program, your contact information is included in email notification broadcasts of Corrective Patches, New Features, New Versions, Tips, etc., everything you need to stay current.

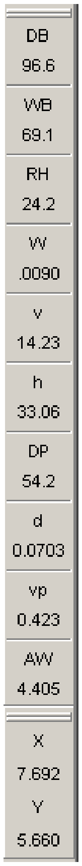


MENUS AND TOOLBARS

Menus and Toolbars

You can access the Psychrometric Analysis services via a standard Windows menu and tool bar system. Each component of the system can be dragged and docked to the top, bottom, left or right sides of the Psychrometric Chart Window, or can become floating menus positioned anywhere within the Psychrometric Window.

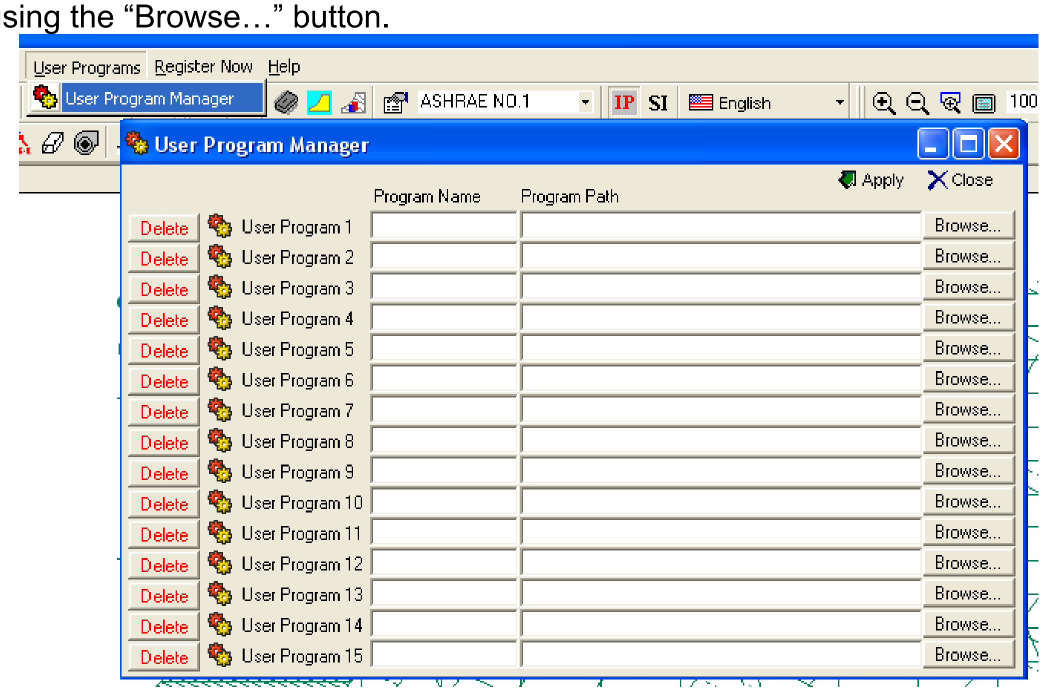




In addition to accessing these services, a constant display of the mouse position in psychrometric property terms is available at all times. The values are displayed in a button bar that can be docked or floating just as the Psychrometric Analysis's other button bars. See the graphic to the left. Let the mouse pointer hover over a value for just a couple of seconds and the engineering units for that value are displayed. The values can be configured for your own needs via the button bar customize option as described above.

Custom User-Defined Menu Toolbars

To add your favorite engineering tools to the Psychrometric Analysis Menu Toolbars, simple click User Programs => User Program Manager and provide a Program Name and locate the program using the "Browse…" button.



PRESENTATION SETTINGS

IP OR SI UNIT CONTROL

You can switch from IP to SI and back with one button click. All State Points and Processes are dynamically recalculated on the fly!!

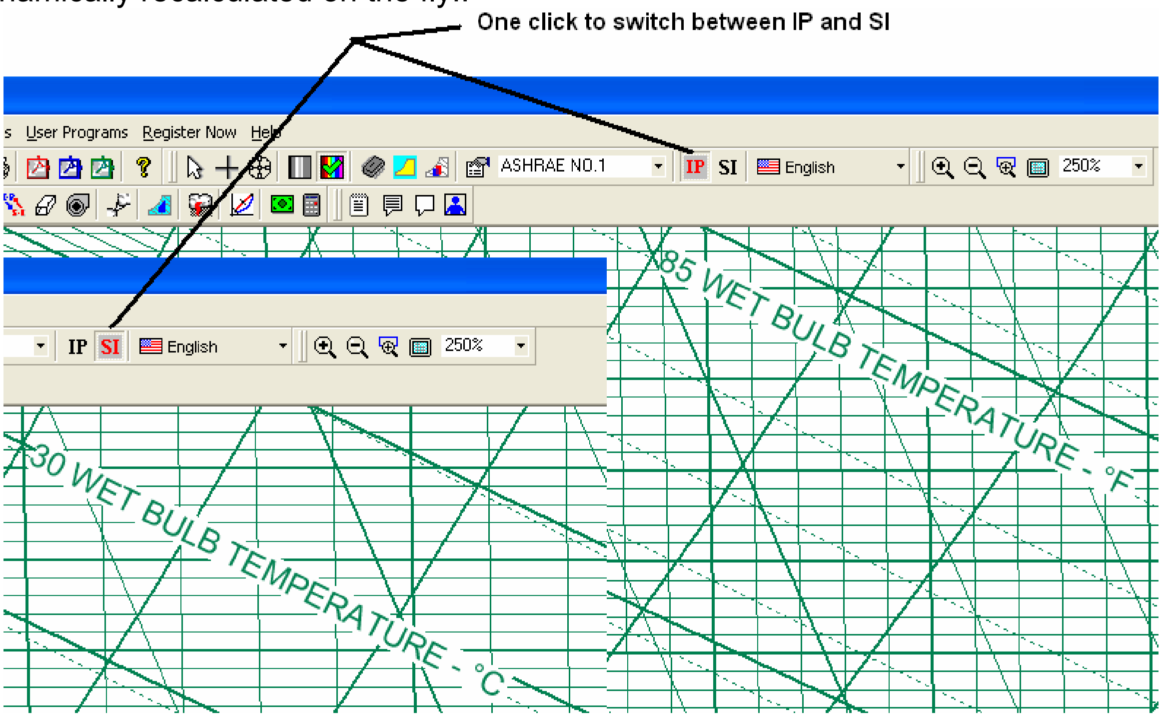
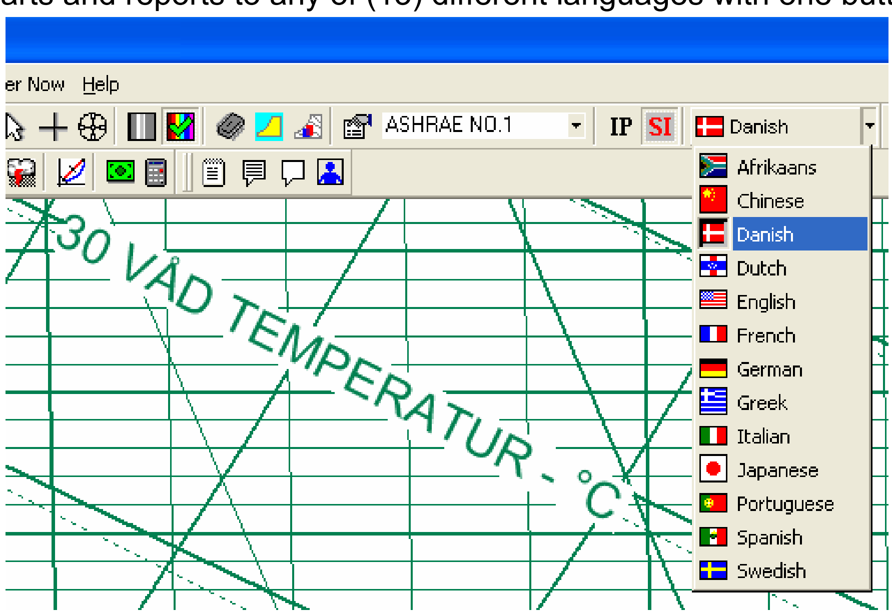


CHART & REPORT LANGUAGE CONTROL

Change your charts and reports to any of (13) different languages with one button click!!



PAGE SETUP CONTROL

Complete page setup control supporting both IP and SI units of measure!

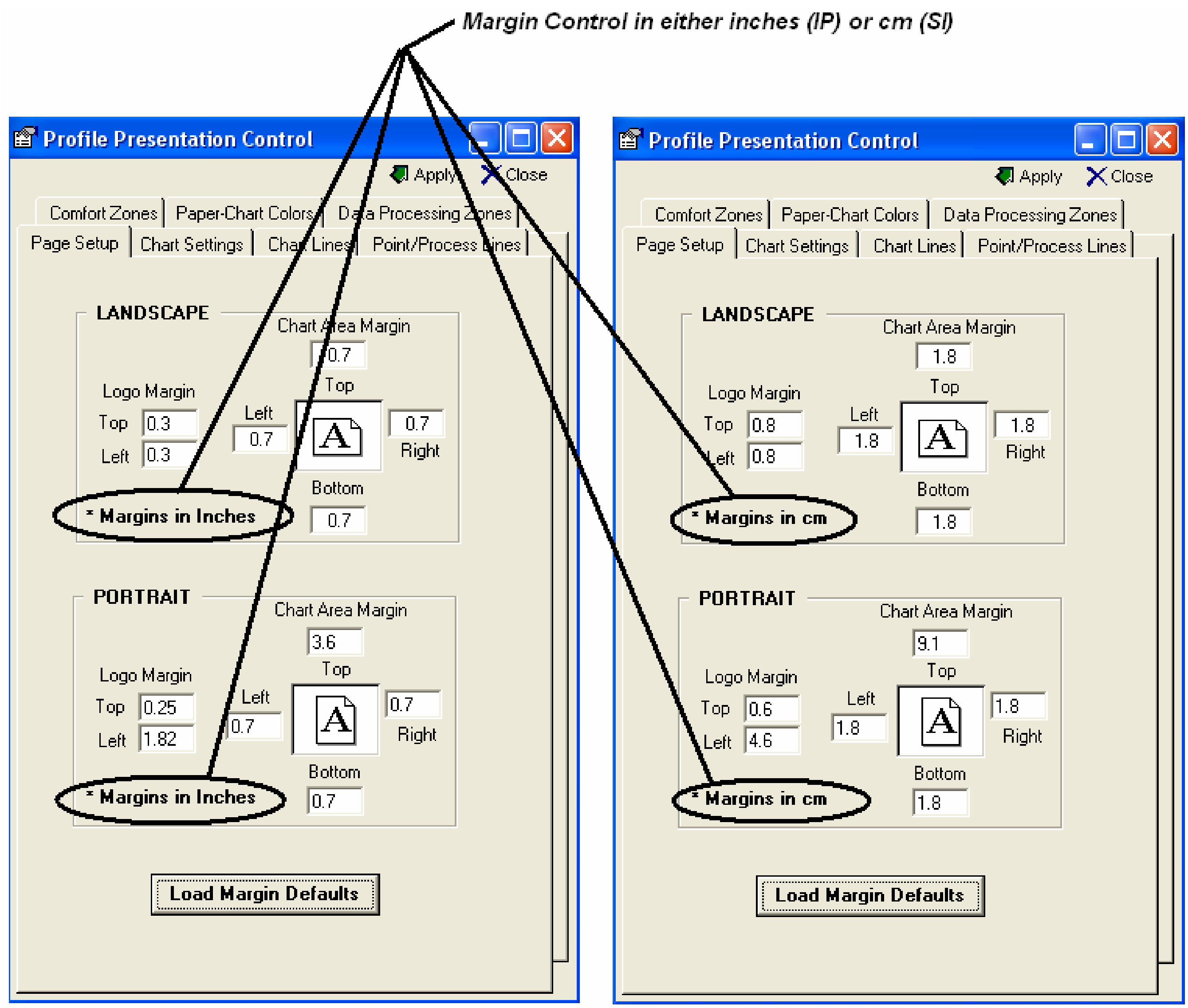
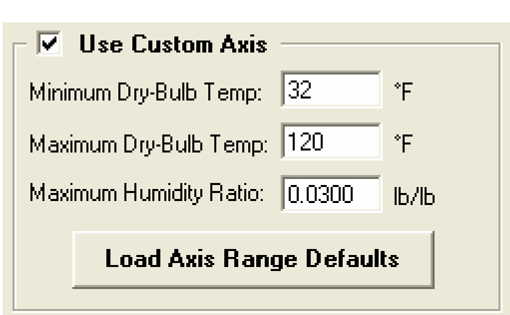
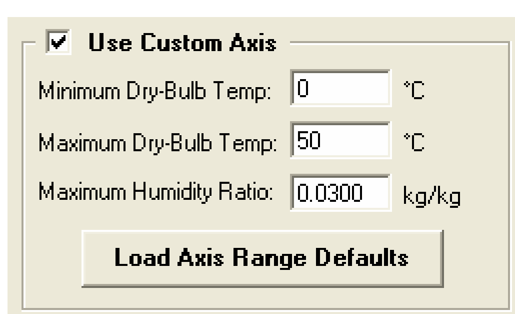


CHART AXIS RANGE CONTROL

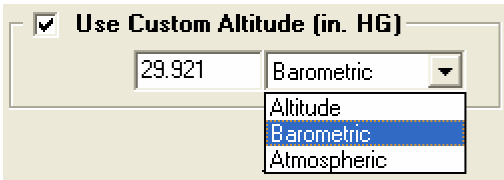
Complete Dry-Bulb and Humidity Ratio Range Control!!





ALTITUDE & PRESSURE CONTROL

Generate Charts and Perform Analysis at virtually any Altitude or Pressure!!



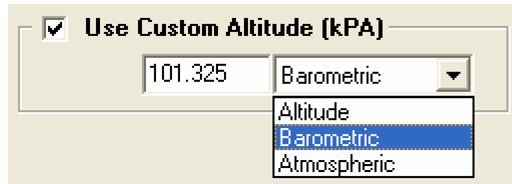
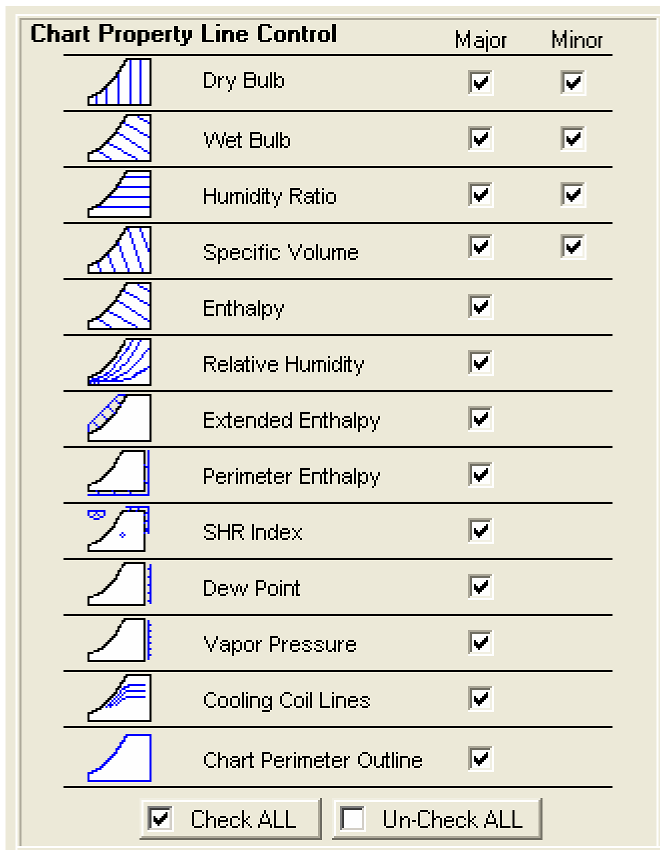


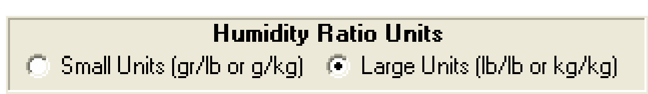
CHART LINE ON/OFF CONTROL

Improved and Enhanced Line Property and Feature On/Off Control!!



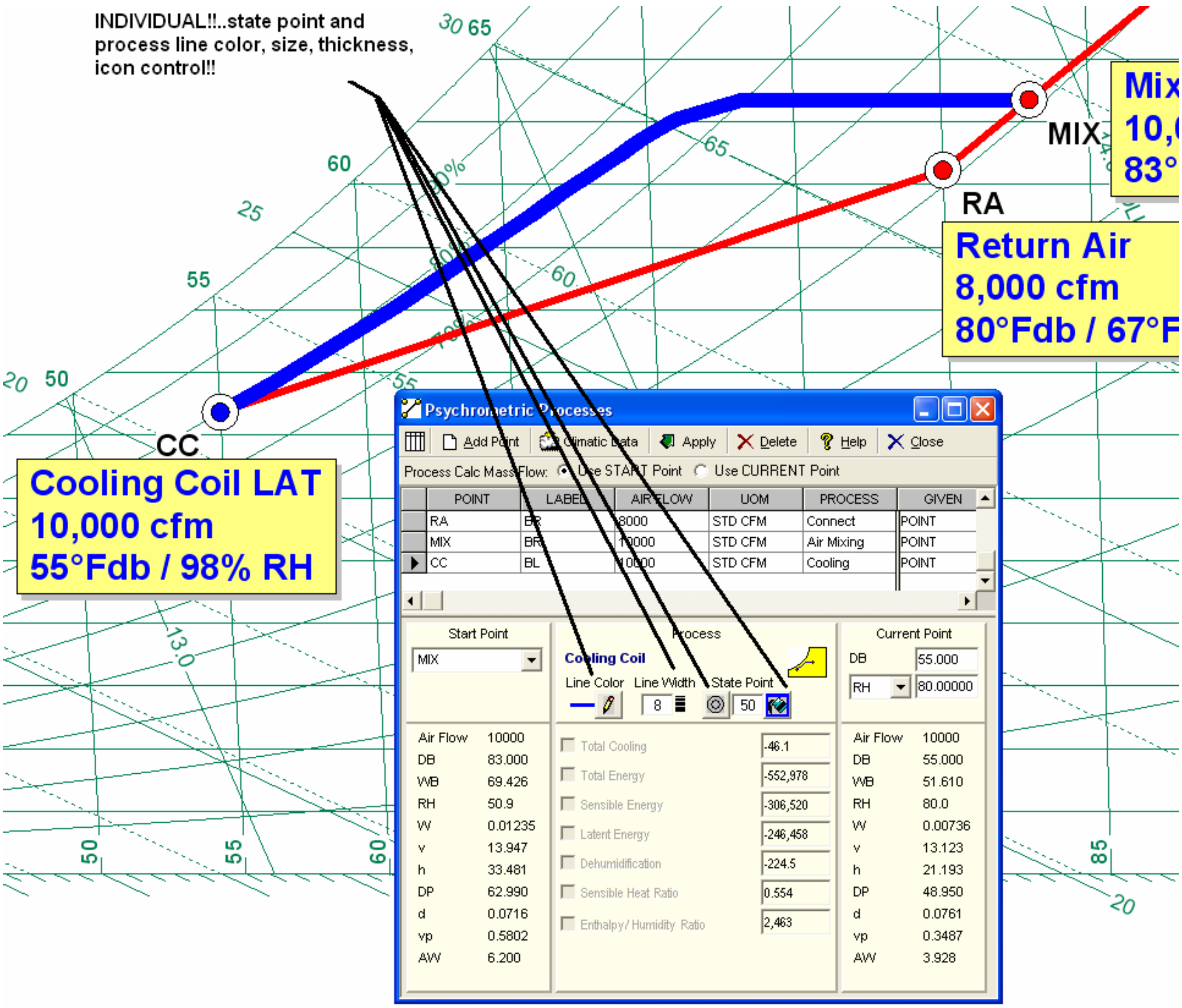
HUMIDITY RATIO UNIT CONTROL

Complete Humidity Ratio Unit of Measure Control!!



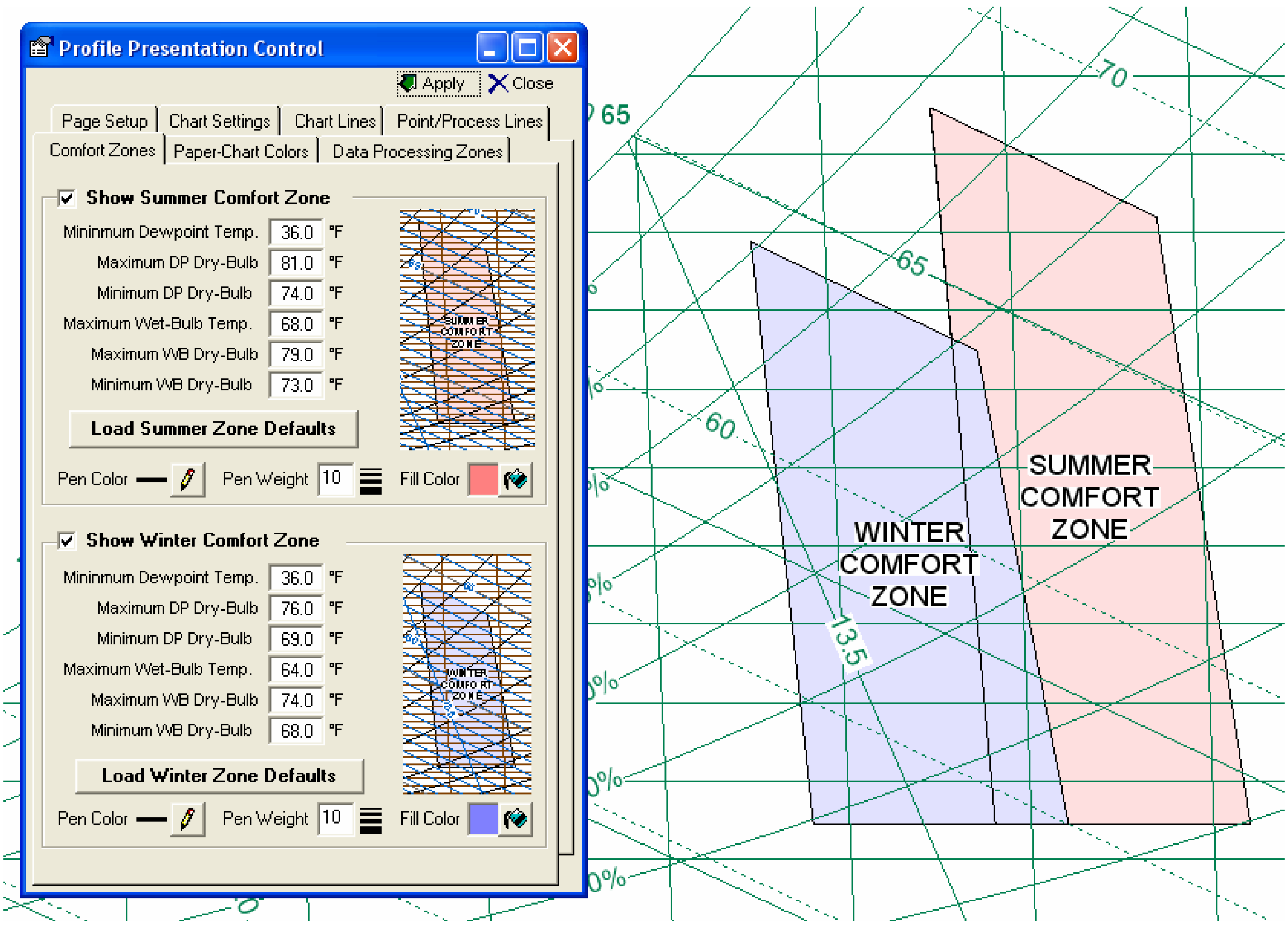
PROCESS LINE & STATE POINT COLOR & SIZE CONTROL

Now you can specify the colors, size, thickness and icons for each individual state point and process!!



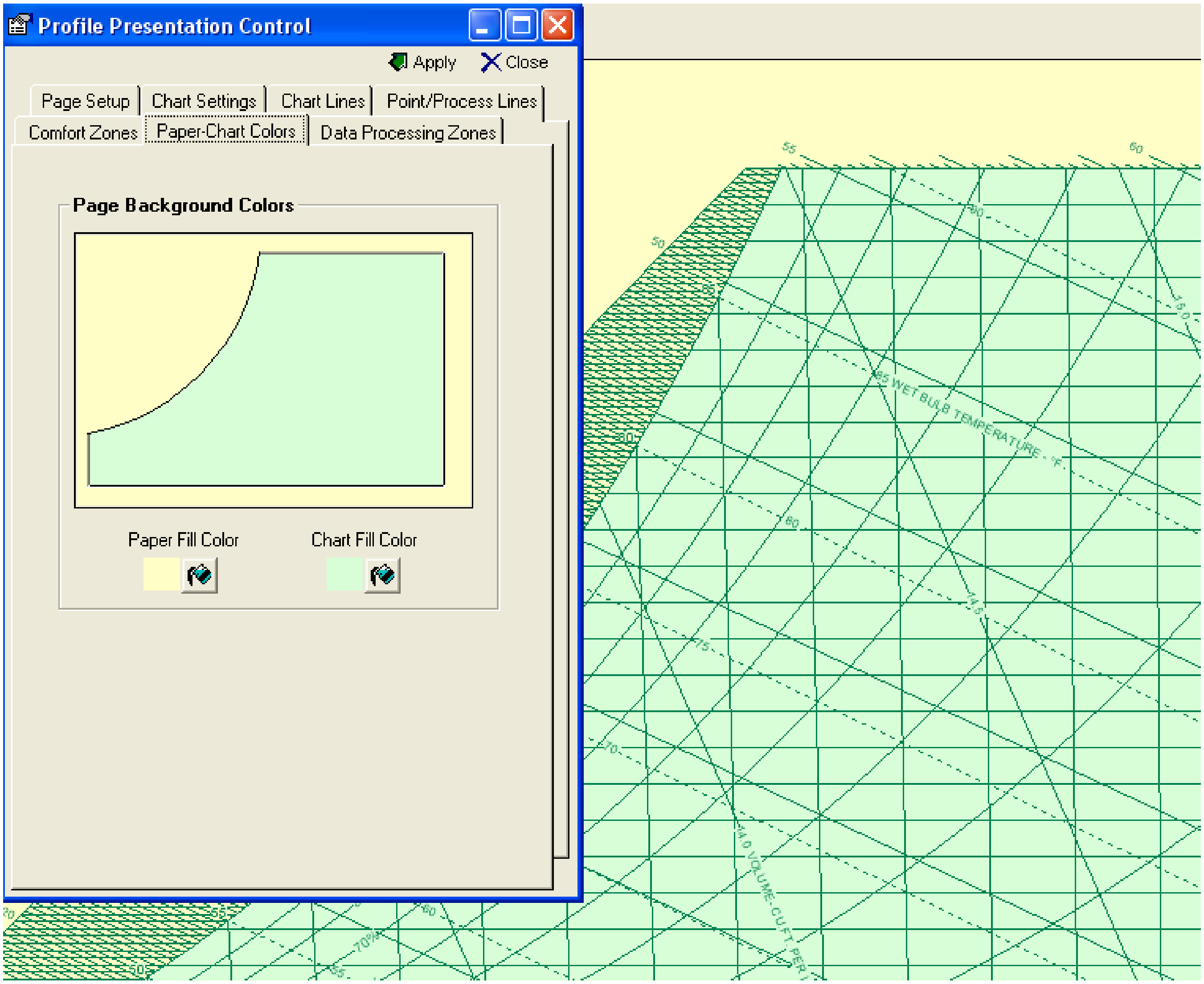
SUMMER & WINTER COMFORT ZONE CONTROL

Seeing the Summer and Winter Comfort Zones is just a button click away, and you can format the line color, weight and area fill color too!!



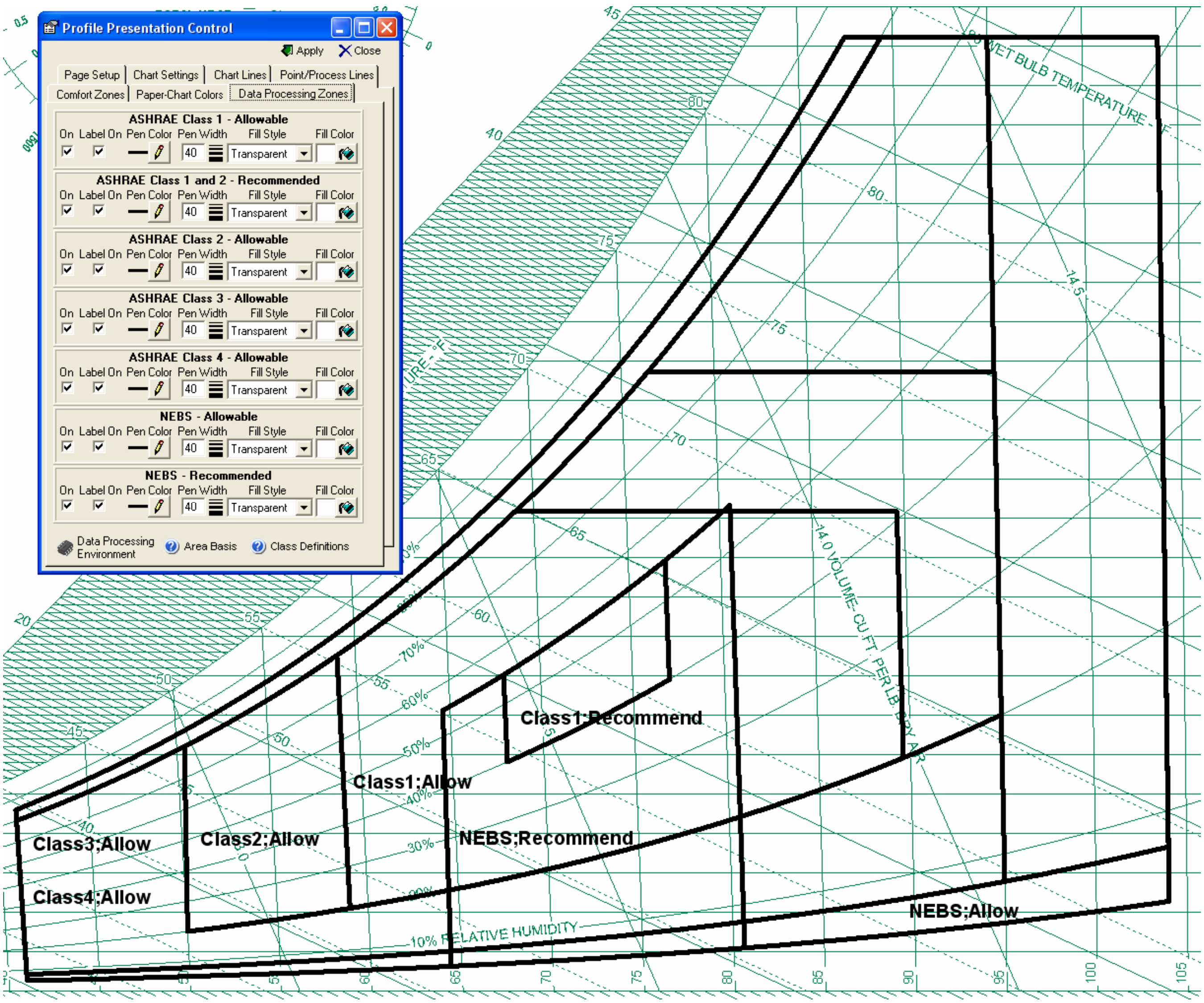
PAPER & CHART AREA COLOR CONTROL

Specifying the chart area and paper area colors is a snap!!



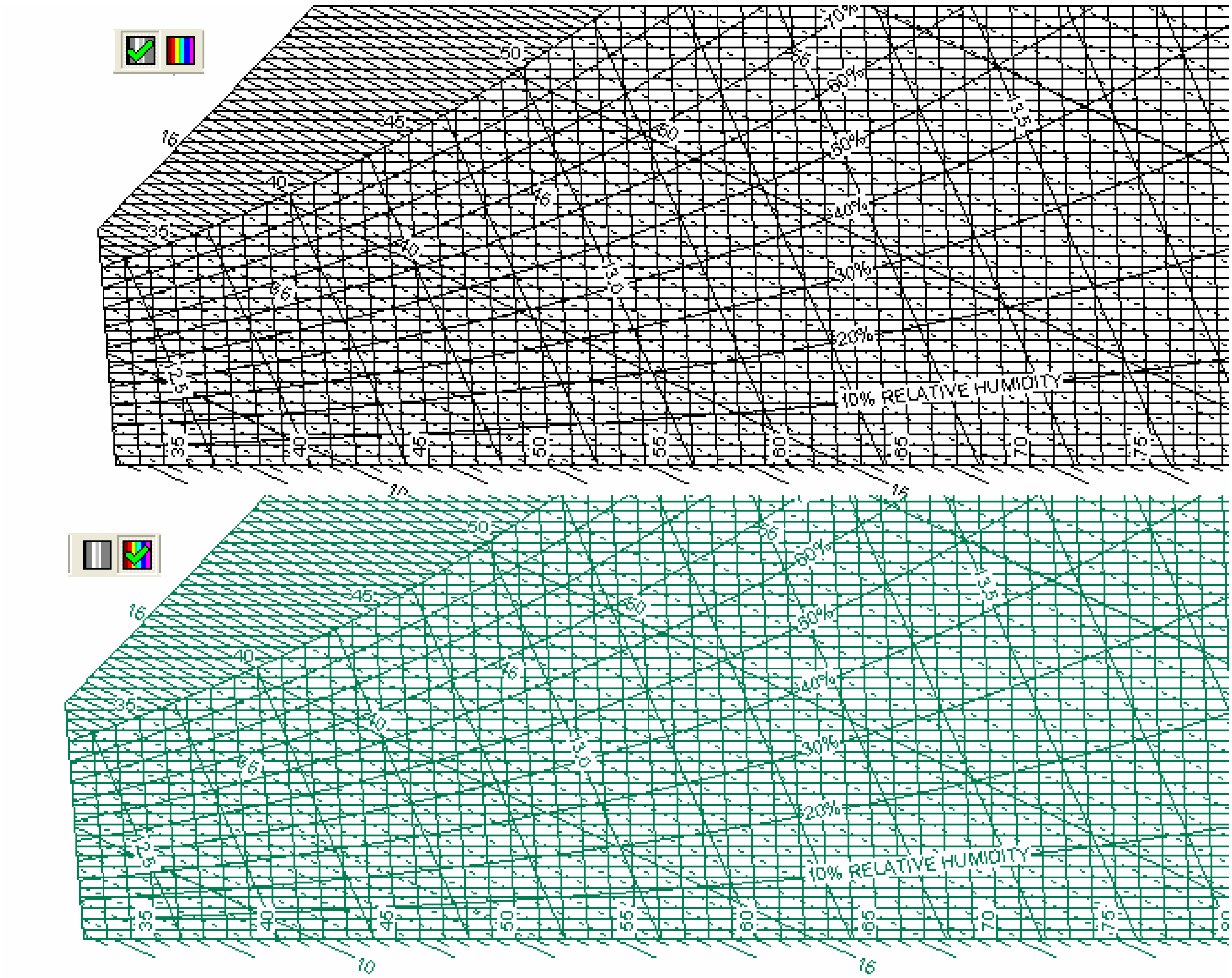
DATA PROCESSING ENVIRONMENT AREA DISPLAY CONTROL

Take the mystery out of the ASHRAE Data Processing Environment Class Areas with one button click!!!...Dynamically adjusts the areas based on altitude or pressure too!!



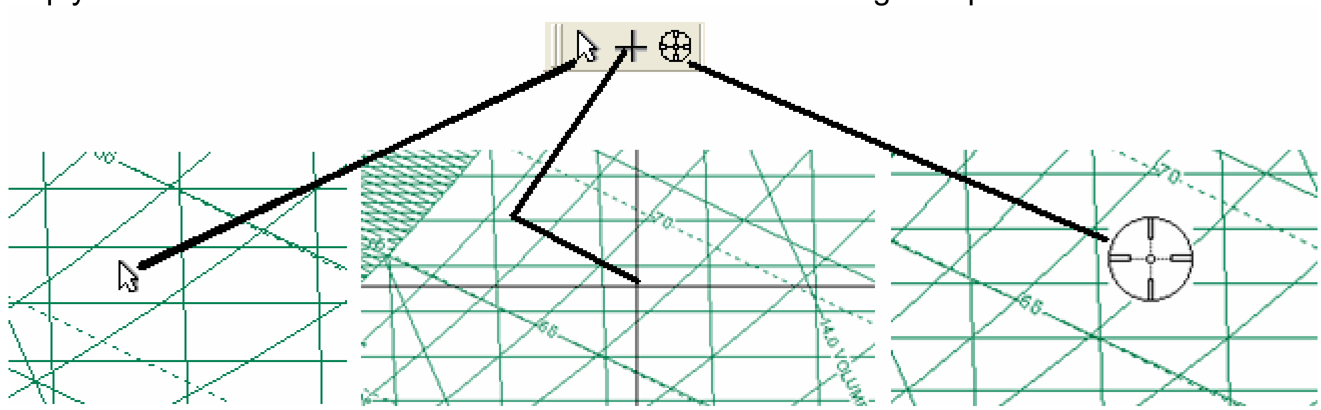
COLOR OR B&W CHART CONTROL

Switch from Color to Black & White and back with just one button click!!!



MOUSE POINTER CONTROL

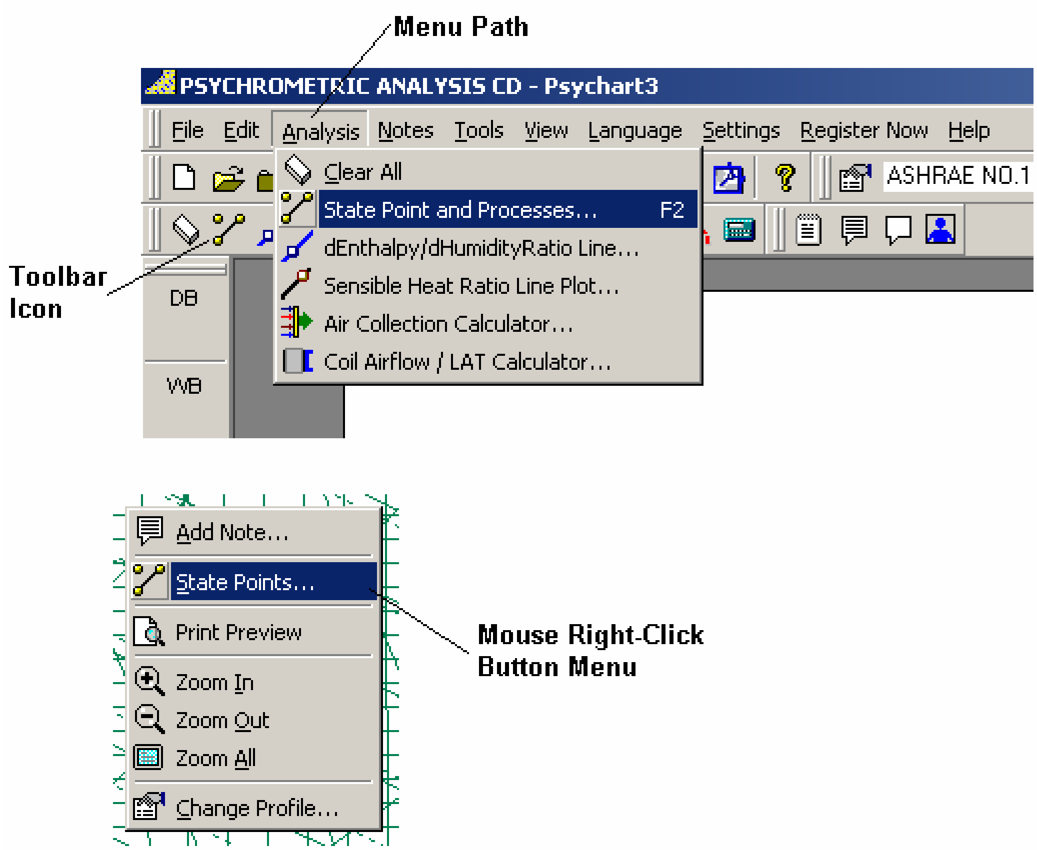
Simply click the icon on the toolbar to select the mouse tracking icon preference!!!



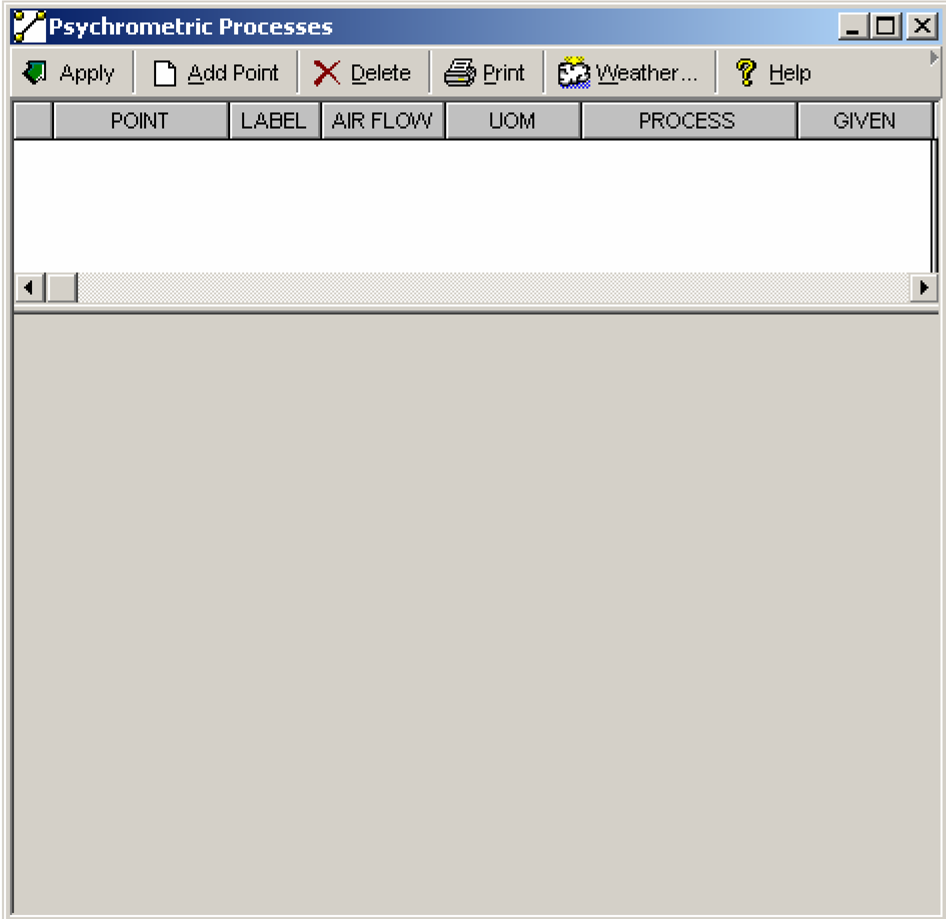
PSYCHROMETRIC ANALYSIS

STATE POINT & PROCESS ANALYSIS

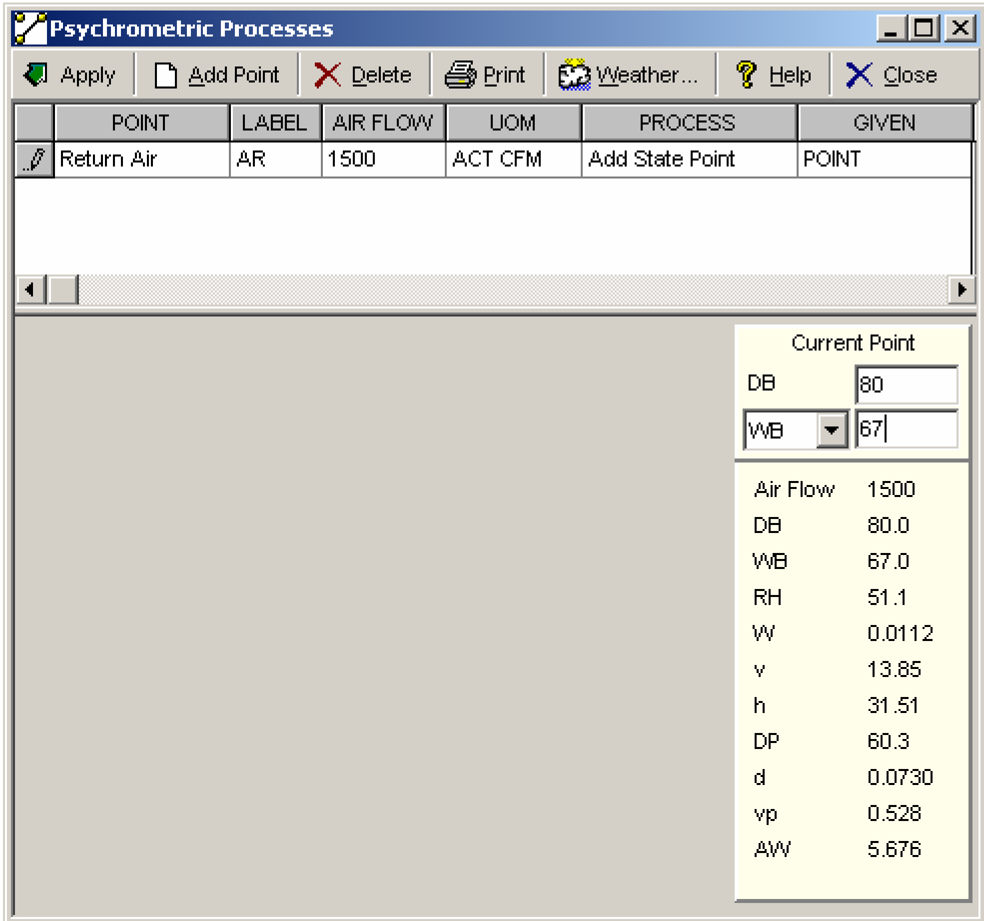
1. Activate "State Point and Processes" by any of the three methods shown below:



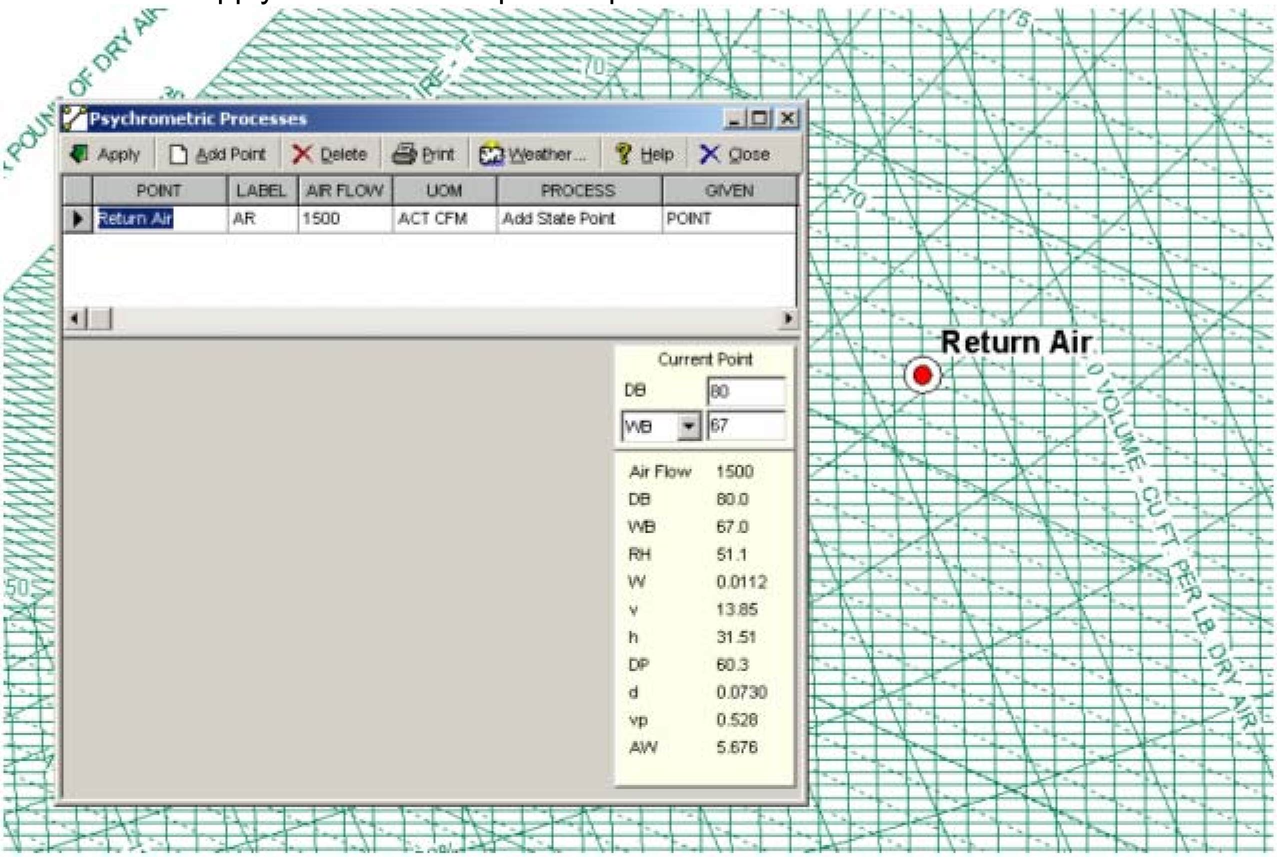
2. The Psychrometric Processes window appears with blank data fields.



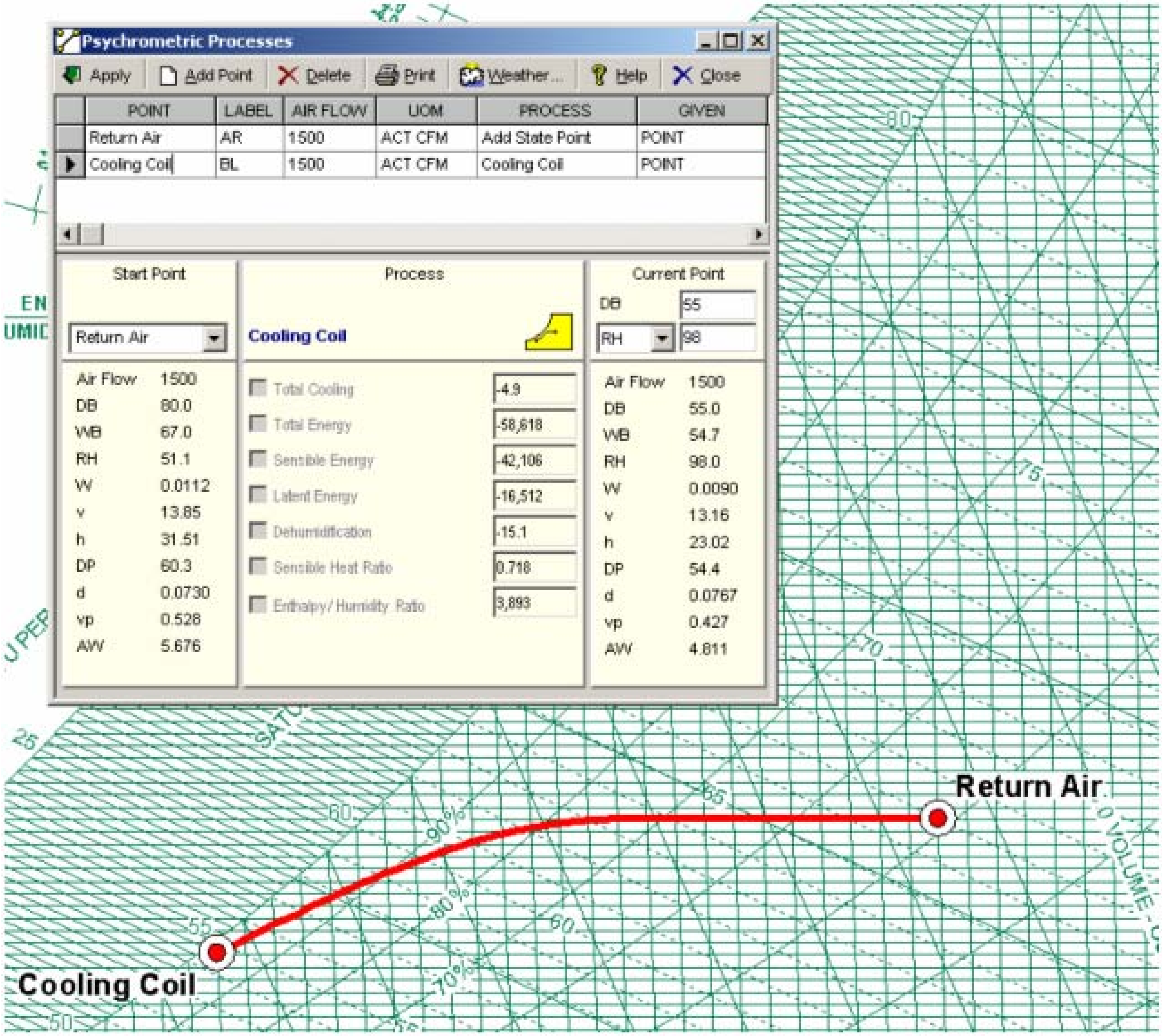
3. To enter a new point, click the Add Point button. Fill in the grid information as needed (point name, point label location, enter the airflow, select air flow units, select process and select given option). If this is the first point, the only process offered is "Add State Point" since there are no other points to create a process with. Click on the "Current Point" panel and enter dry bulb temperature, enter moisture value and select moisture property from the drop-down box.



4. Click on the Apply button and the point is plotted to the chart.

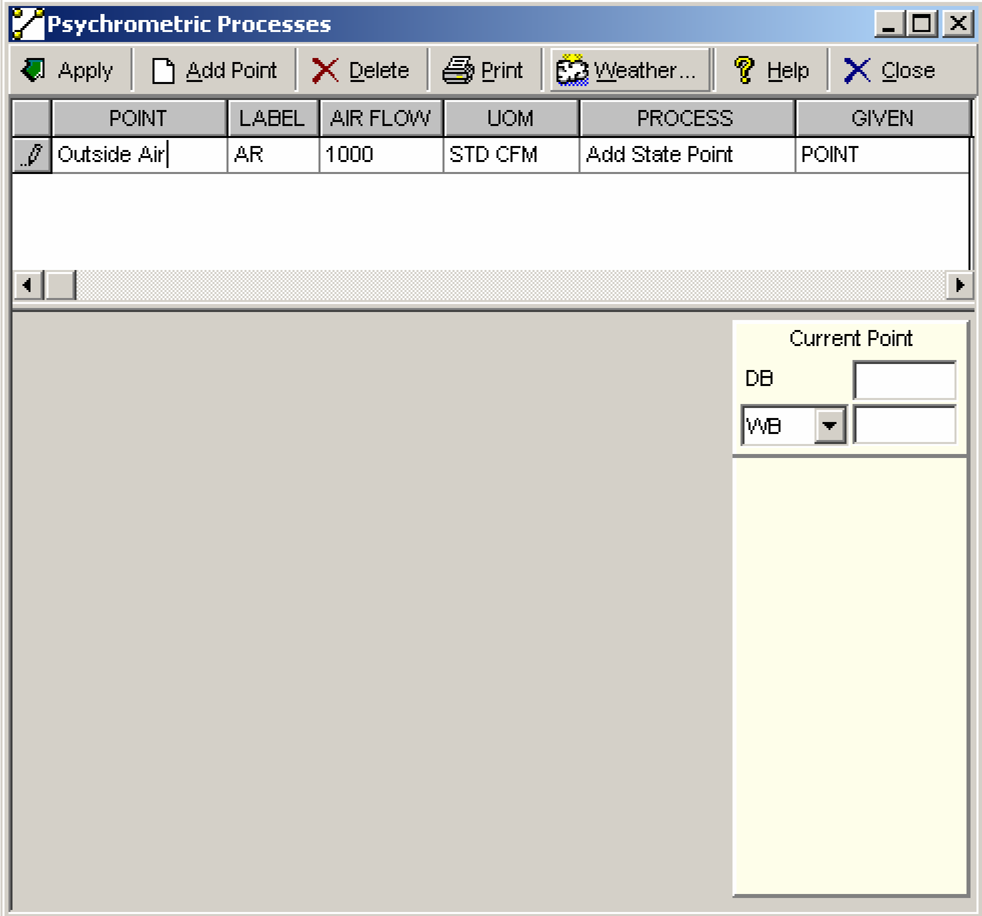


5. Click the Add Point button again to continue adding new points. Adding more than one point enables additional PROCESSES to be selected in the grid. The GIVEN column will also be enabled, after the first point is entered, to allow entering either the end point (POINT), calculating the process energy or entering the process energy (ENERGY) and calculating the end point. After each successive point, click the Apply button to plot the point and process to the chart.

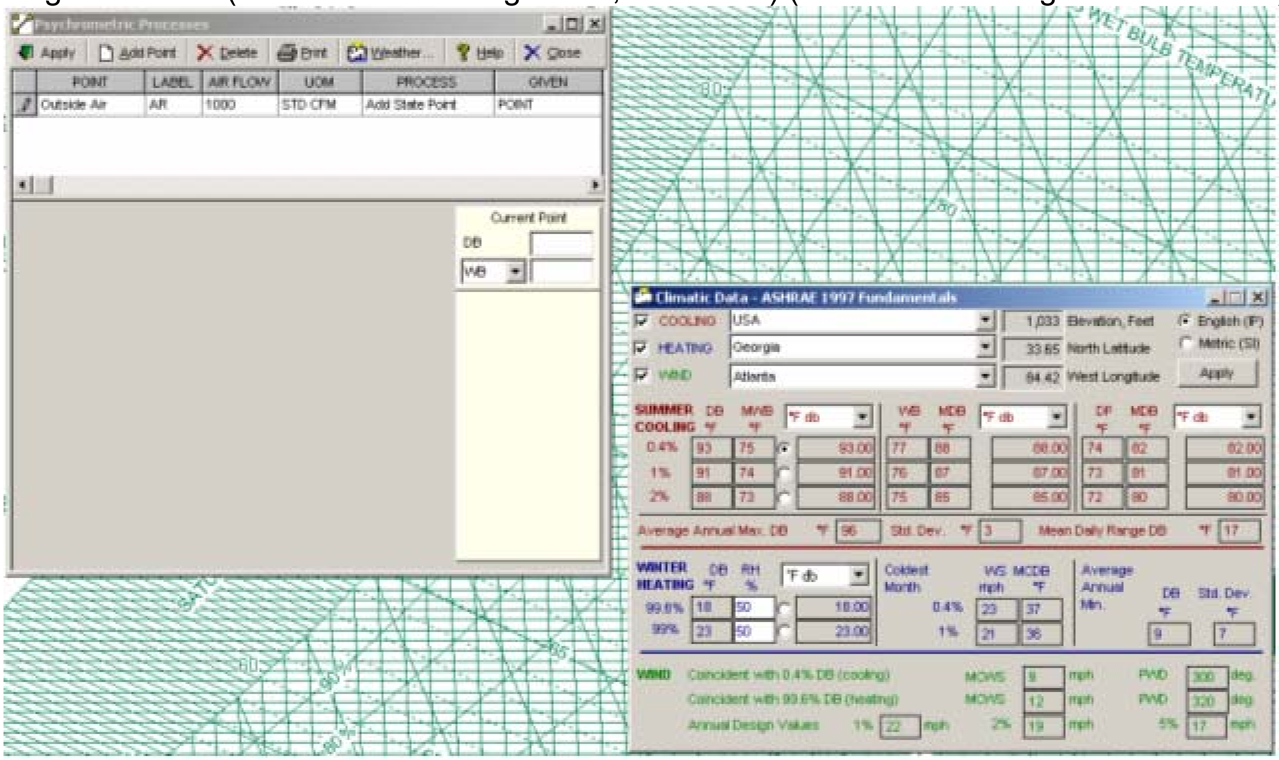


Additional processes can be added to complete any system. If you need to make changes you may do so to any point by just clicking on the proper grid row, make any desired changes and simply click "Apply" and the point and connecting processes are automatically updated.

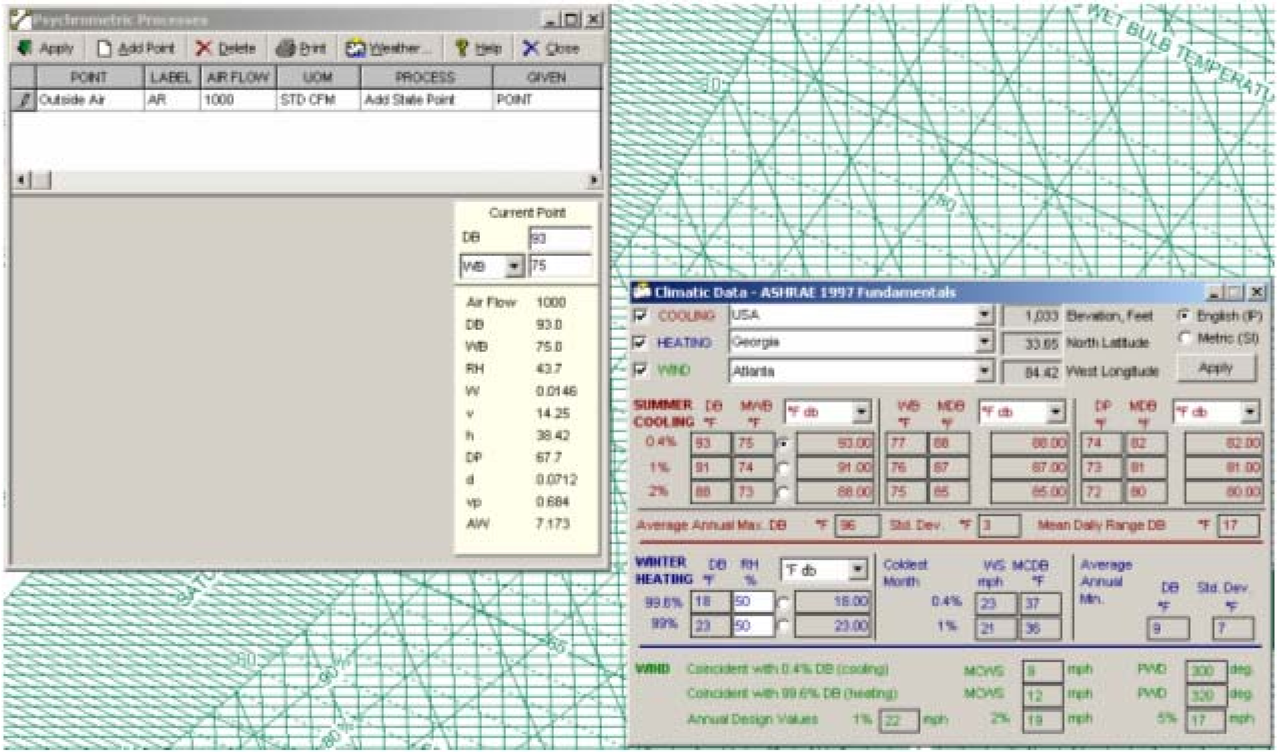
6. To apply a Climatic Data weather point to the chart, simply click on the Weather icon to access the Climatic Data Window.



7. Select the geographic location by country, state and city. Select the desired outside design condition (for Summer Cooling: 0.4%, 1% or 2%) (for Winter Heating: 99.6% or 99%).

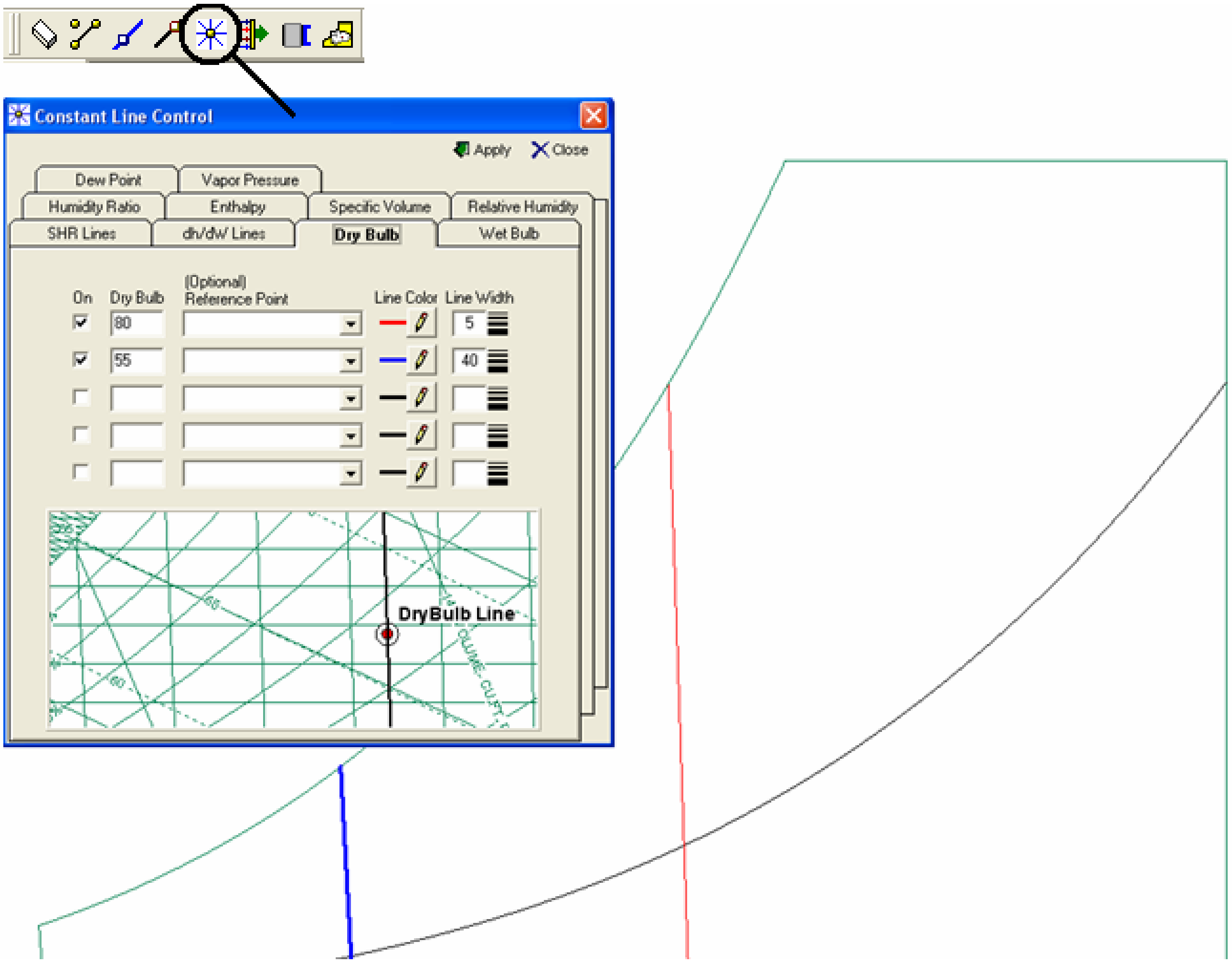


8. To apply this design condition as a State Point, simply click the Apply button in the upper left hand of the Window and then close the Climatic Data Window to return to State Points & Processes.



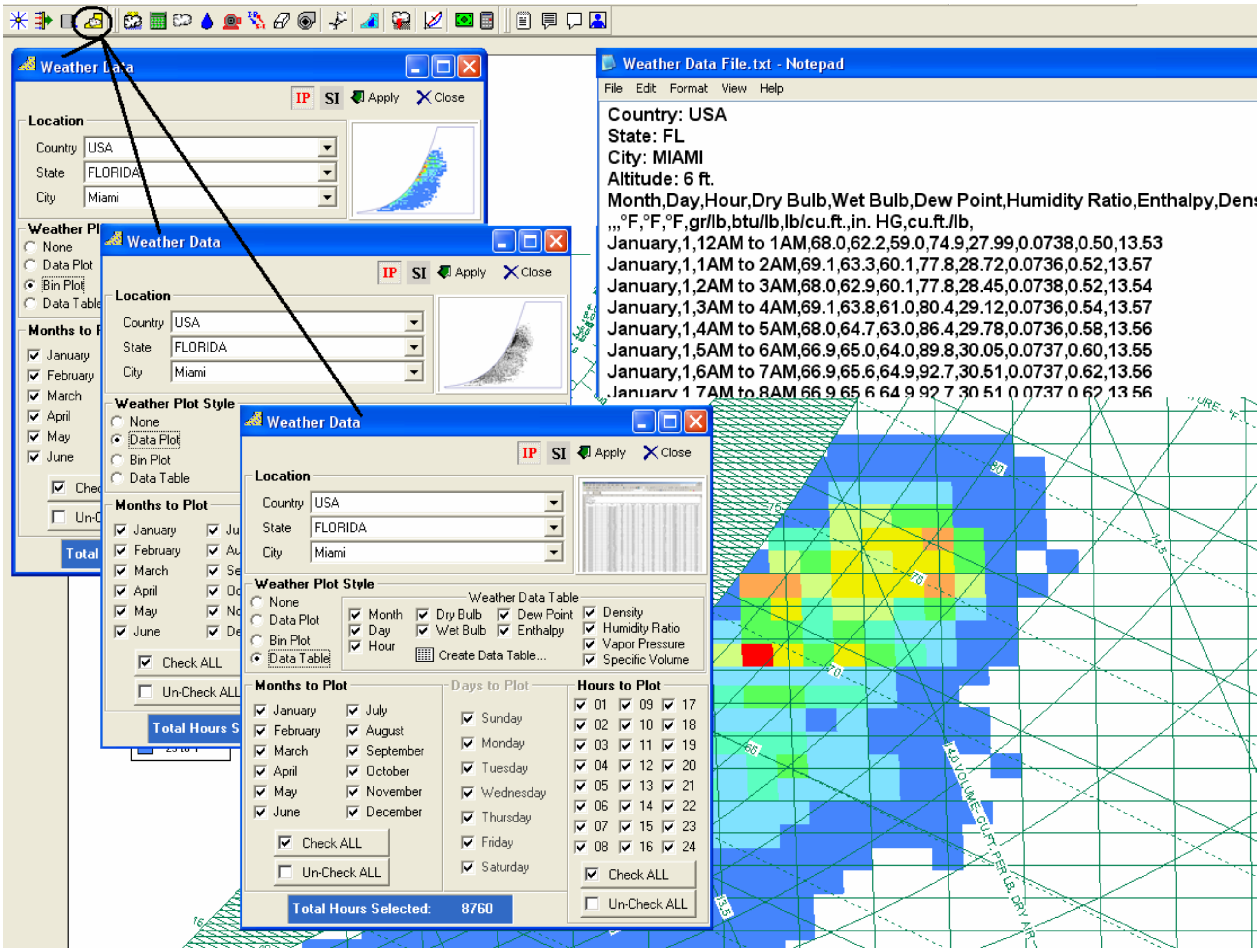
CONSTANT LINE CONTROL

Click the Constant Line Icon on the toolbar, select the line type and specifics, and click “Apply” to see the specified line displayed on the chart!!



WEATHER DATA PRESENTATION CONTROL

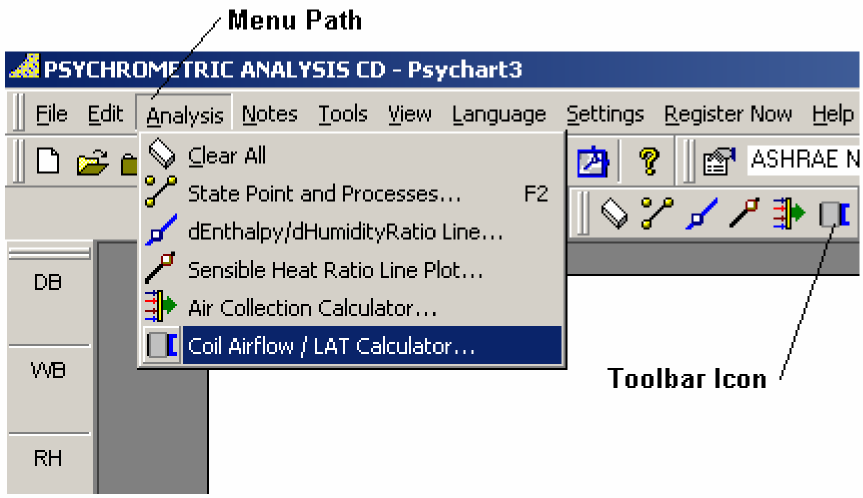
Simply click the Weather Icon on the toolbar and select the location, style and bins desired and with one button click, you can SEE the weather data on the chart as data dots, colored bins or even CREATE your OWN Bin Weather Table!!!



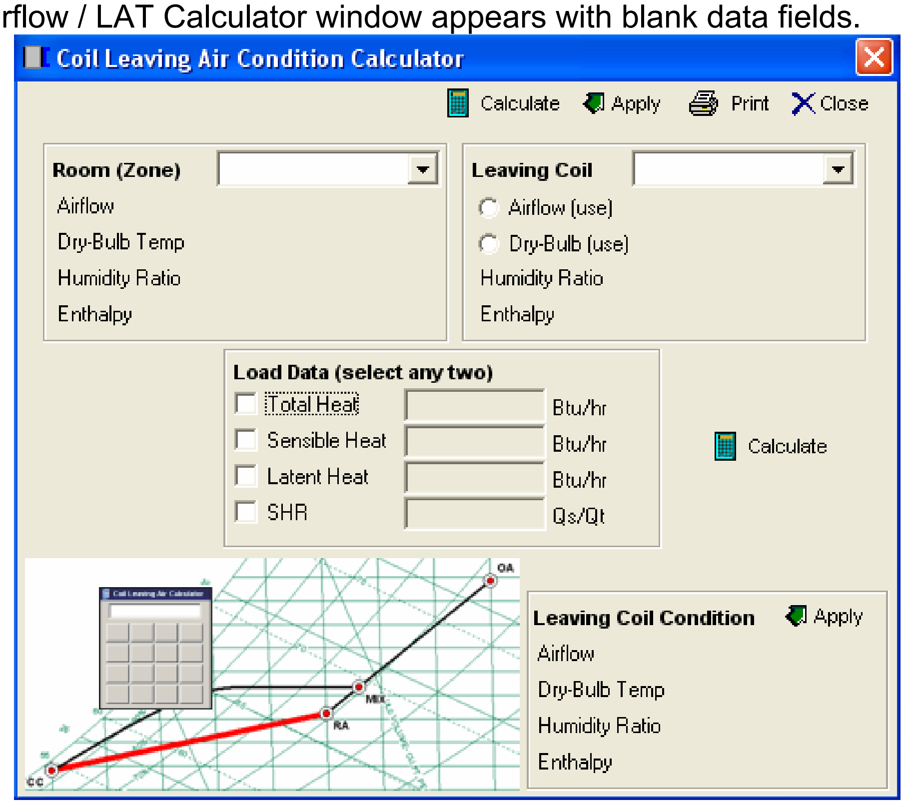
COIL LEAVING AIR CALCULATOR

1. **NOTE:** You need to have the Room Zone state point and Coil state point created for reference by the Coil Airflow/LAT Calculator **BEFORE continuing**.

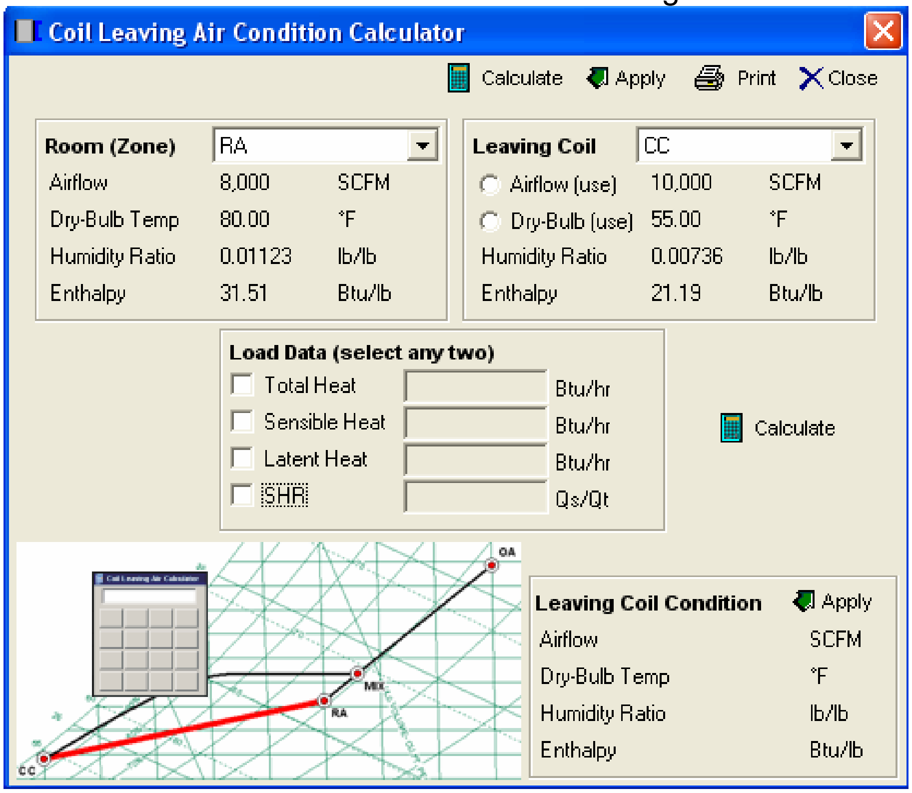
2. Activate "Coil Airflow / LAT Calculator" by either of the two methods shown below:



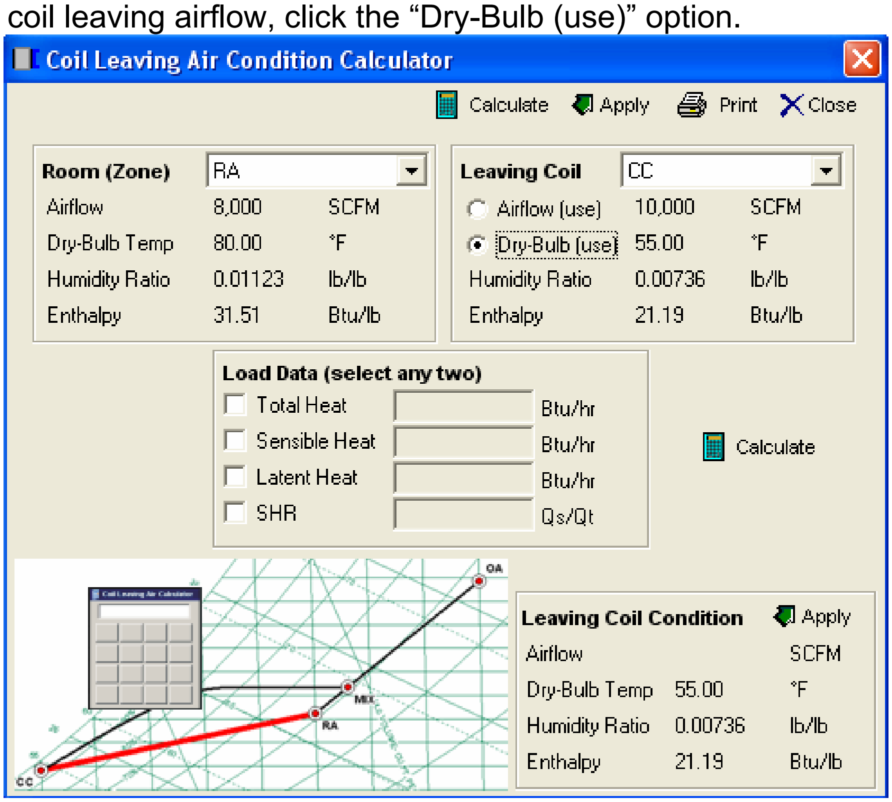
3. The Coil Airflow / LAT Calculator window appears with blank data fields.



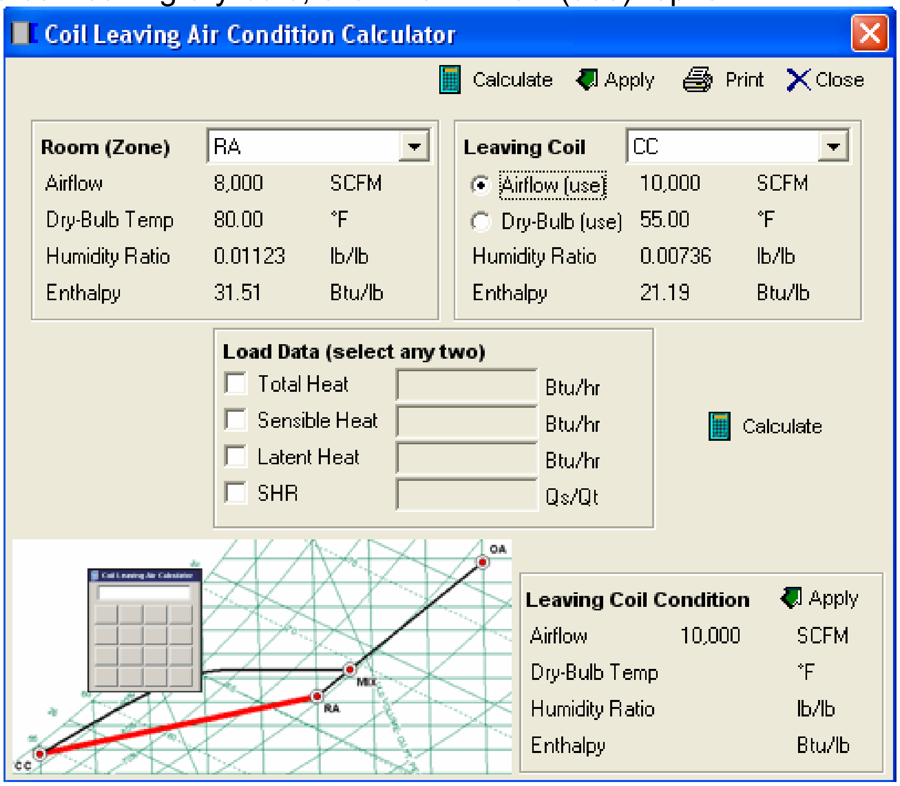
4. Click the Room (Zone) and Coil combo box drop-downs and select the desired points that you've already created with the State Point and Process dialog.



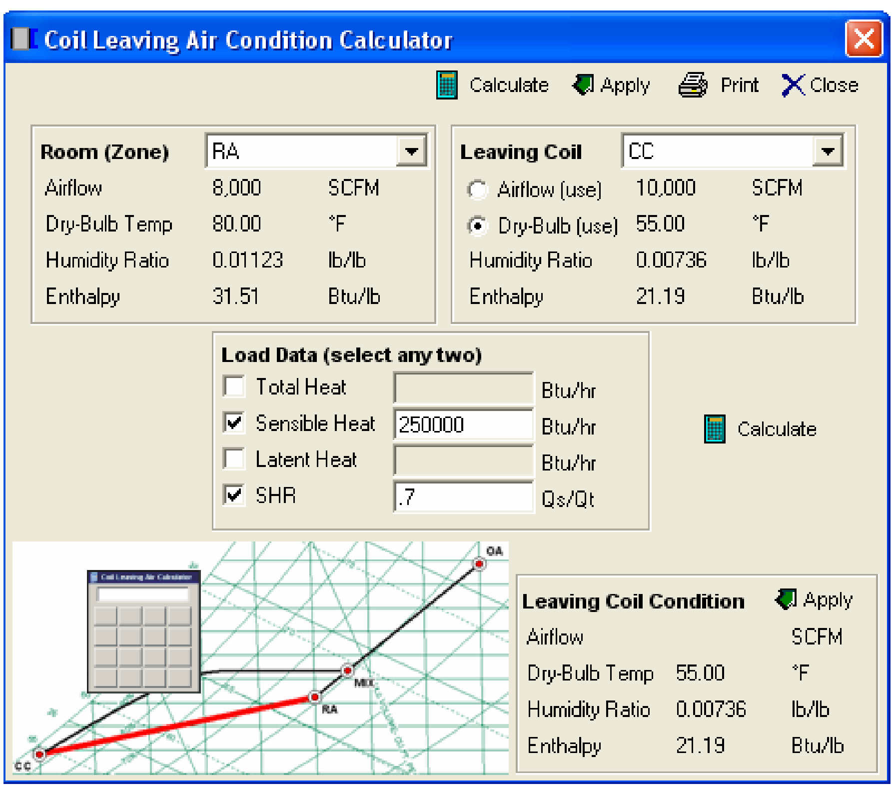
5. To calculate coil leaving airflow, click the "Dry-Bulb (use)" option.



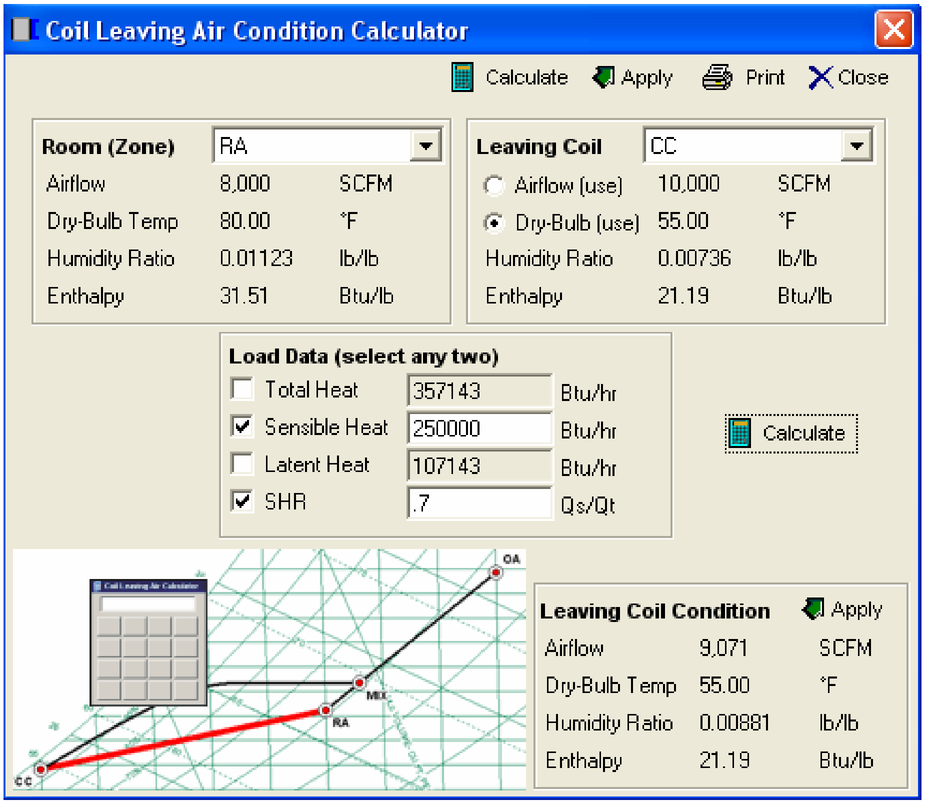
6. To calculate coil leaving dry-bulb, click the “Airflow (use)” option.



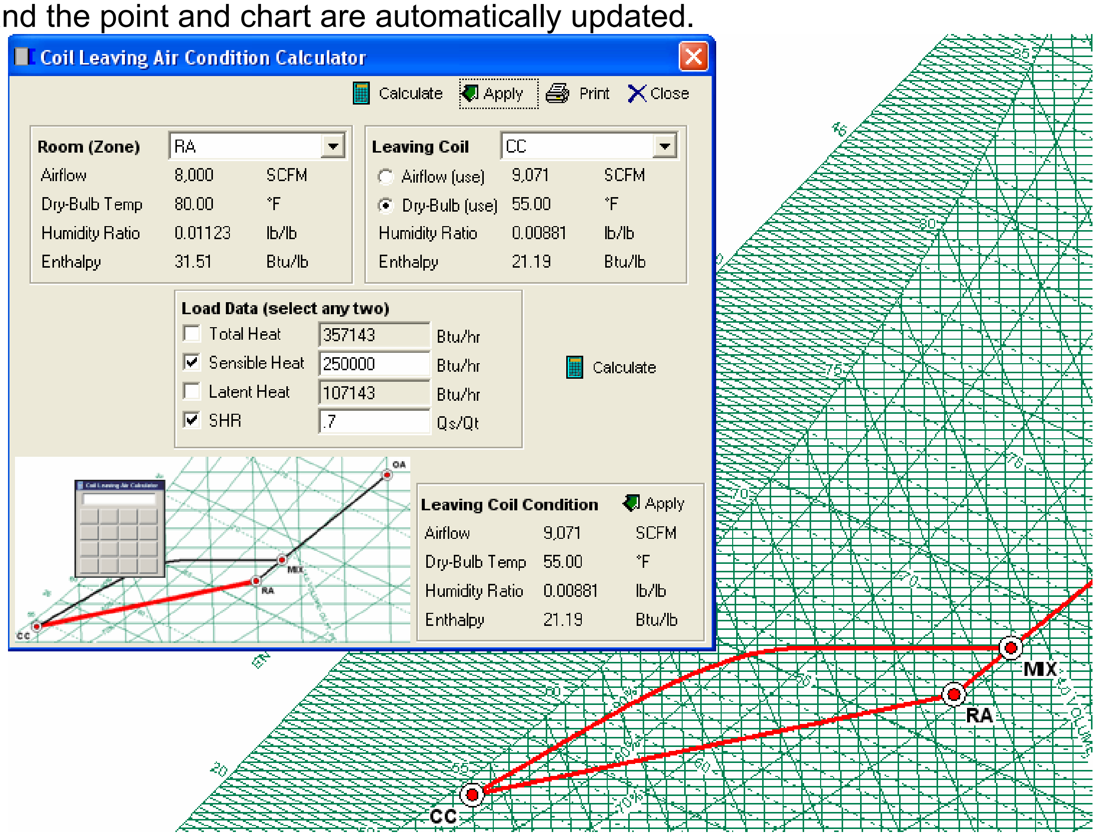
7. Click any two of the Load Data variables you wish to specify and input the appropriate values.



8. Lastly, click “Calculate” to see the results.



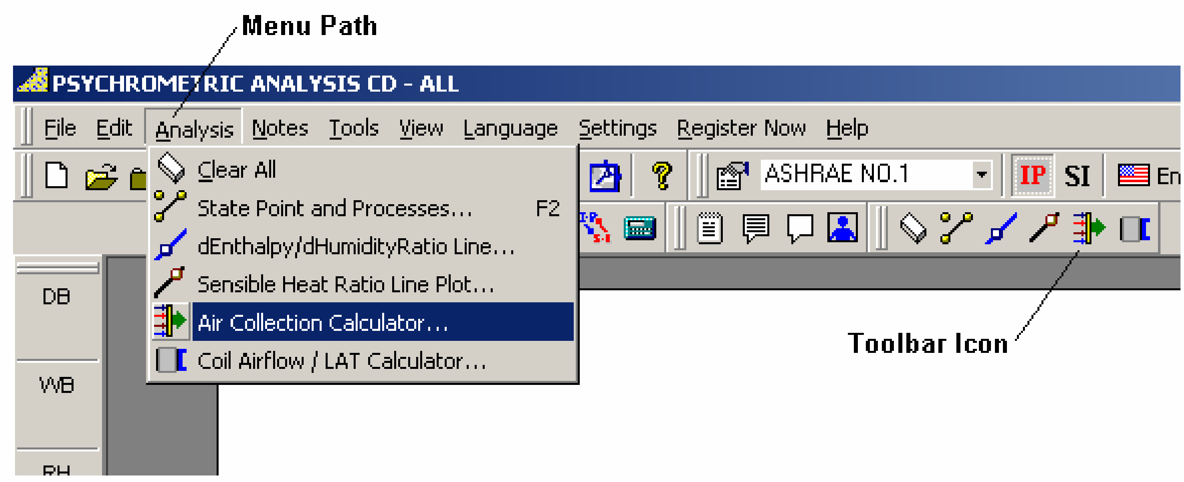
9. To Update the Coil LAT point created with the calculated result, simply click “Apply” on the menu and the point and chart are automatically updated.



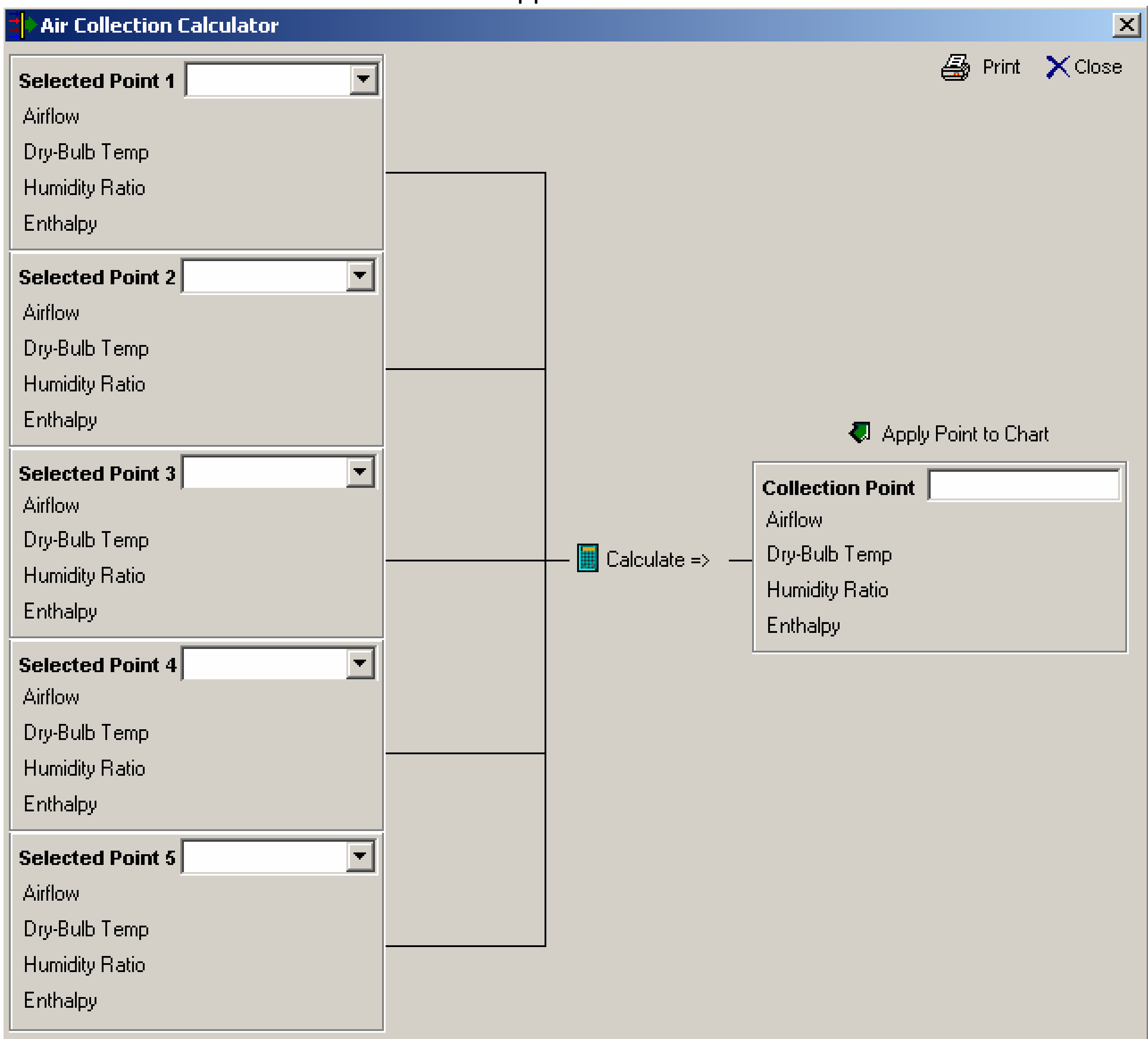
AIR COLLECTION CALCULATOR

1. NOTE: You need to have two or more points created BEFORE calculation of a collection point can be performed.

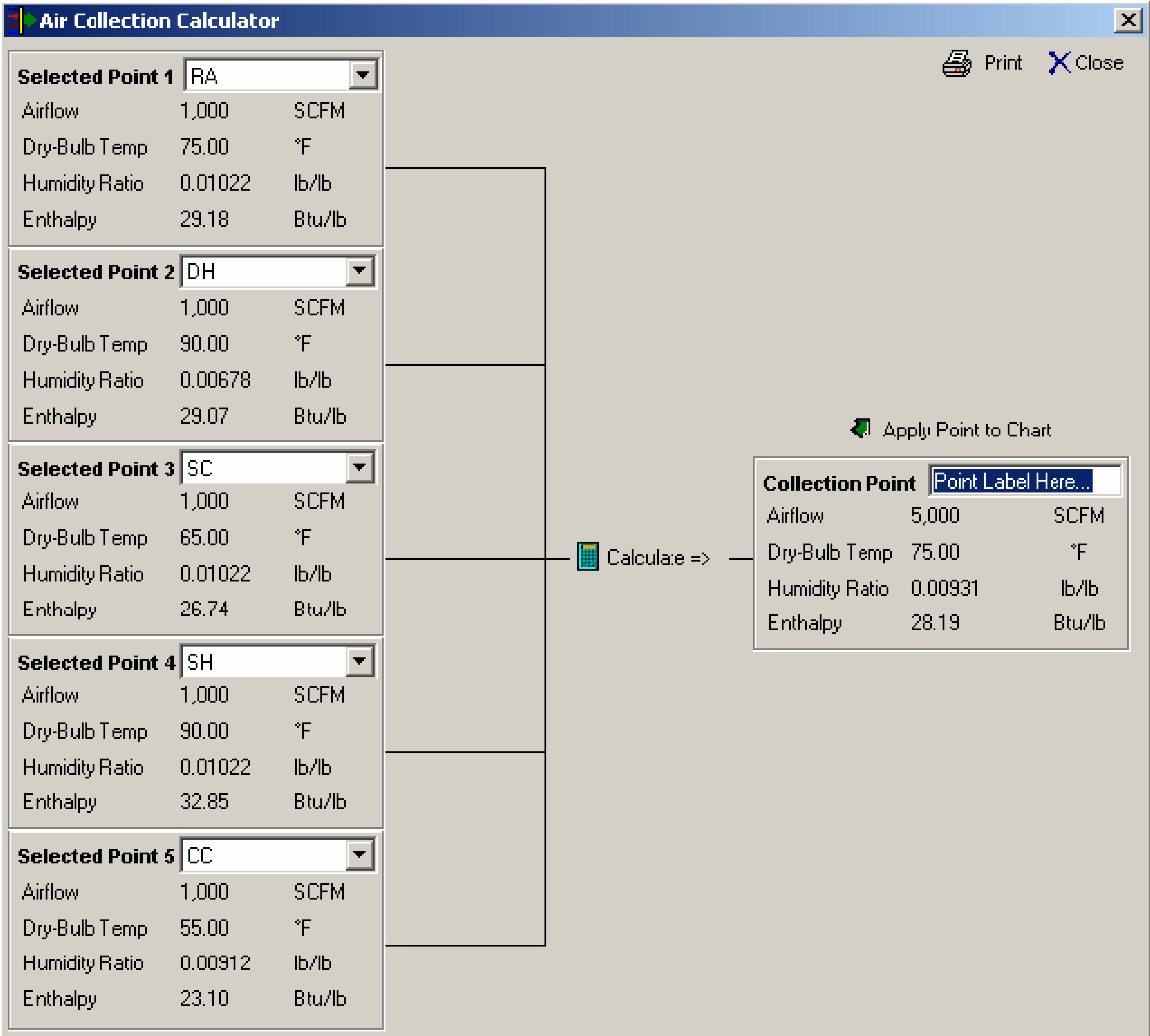
2. Activate "Air Collection Calculator" by either of the two methods shown below:



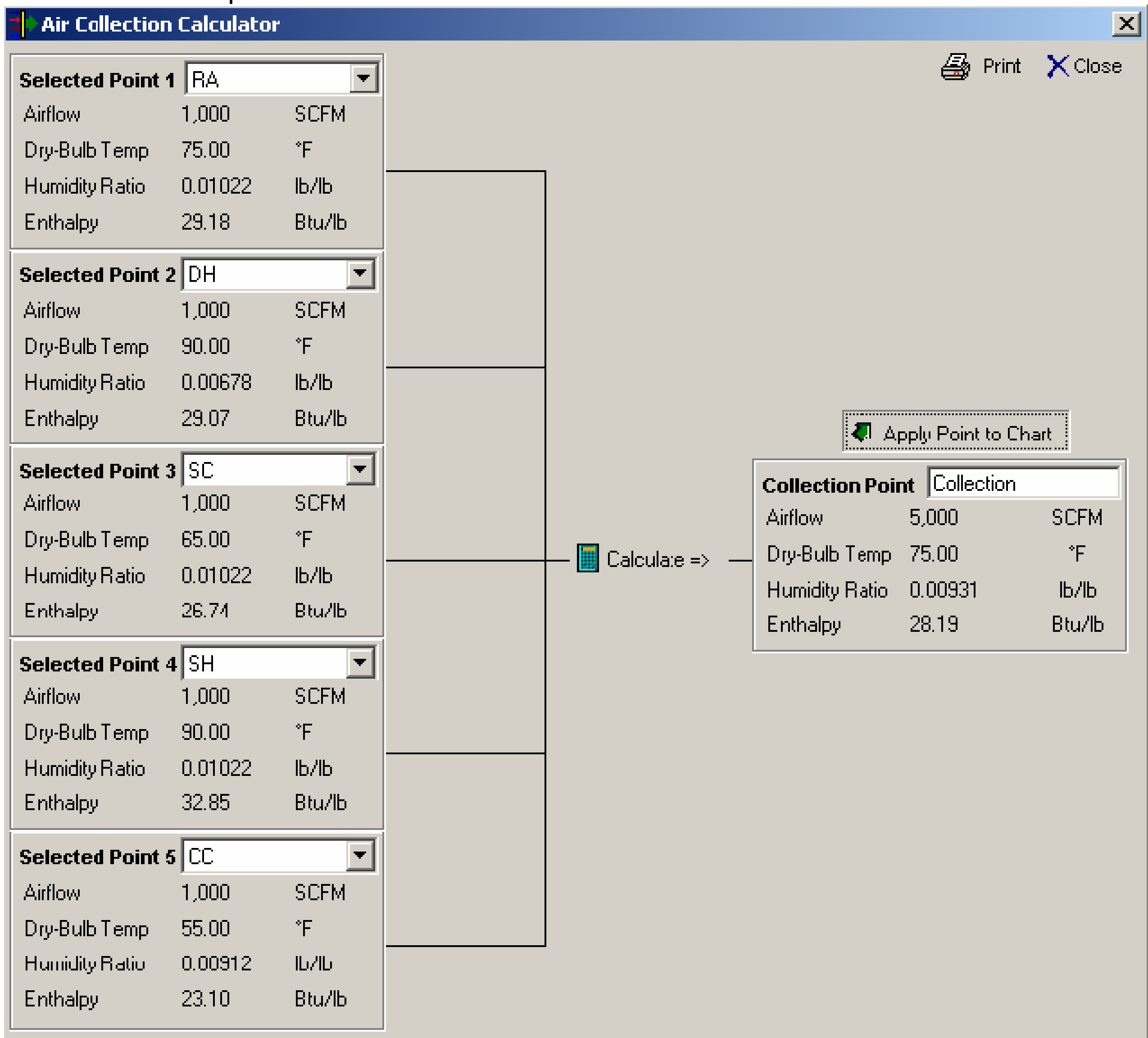
3. The Air Collection Calculator window appears with blank data fields.



4. Click the Selected point combo box drop-downs to specify the points you wish to collect, then click "Calculate =>" to see the Collection Point result.



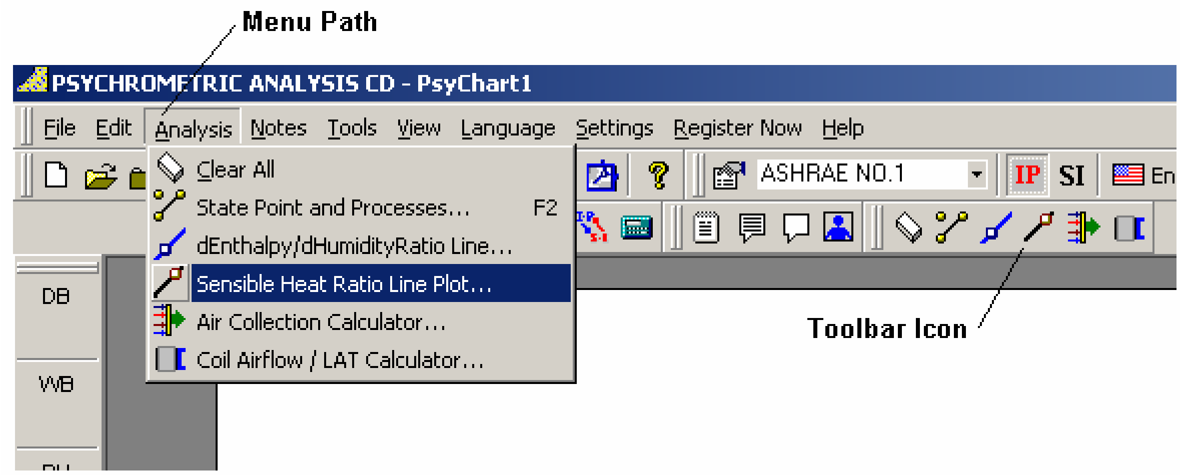
5. Type in the desired Point Label and click "Apply Point to Chart" to add the Collection Point to the chart and report.



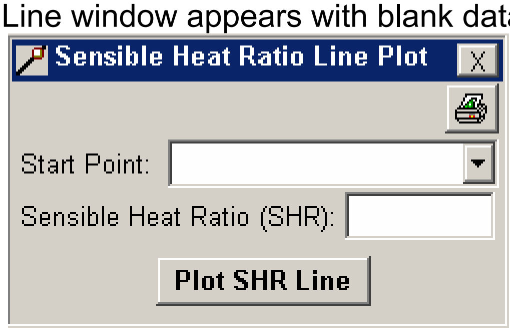
SENSIBLE HEAT RATIO LINE PLOTTING

1. NOTE: You need to have at least ONE point created BEFORE calculation of a constant sensible heat ratio line can be performed.

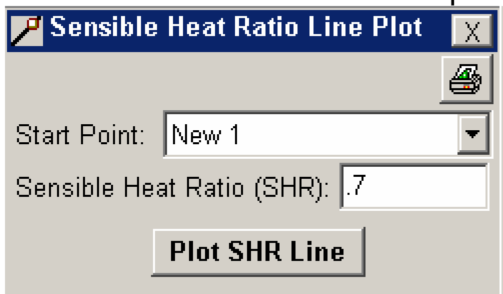
2. Activate "Sensible Heat Ratio Line Plot" by either of the two methods shown below:



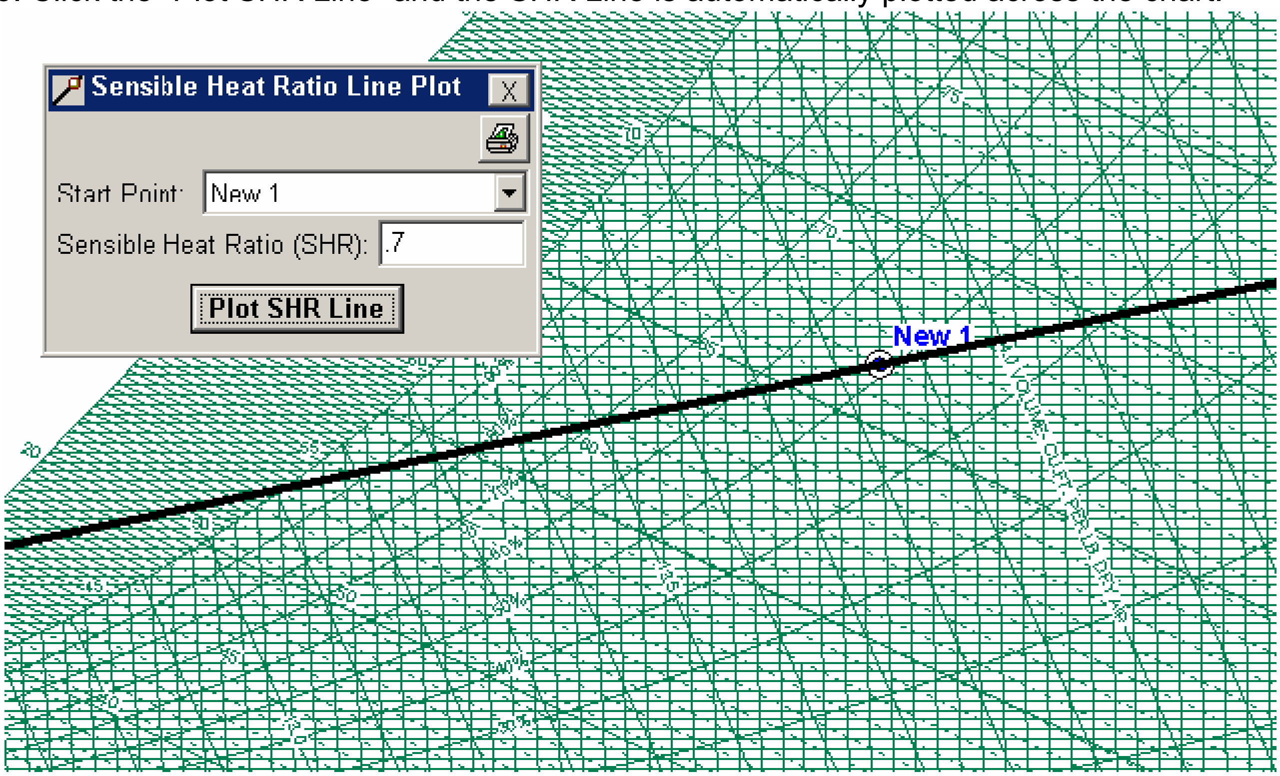
3. The Sensible Heat Ratio Line window appears with blank data fields.



4. Click the Start Point combo box drop-down to select a reference state point to plot through. Then type in the desired sensible heat ratio in the space provided.



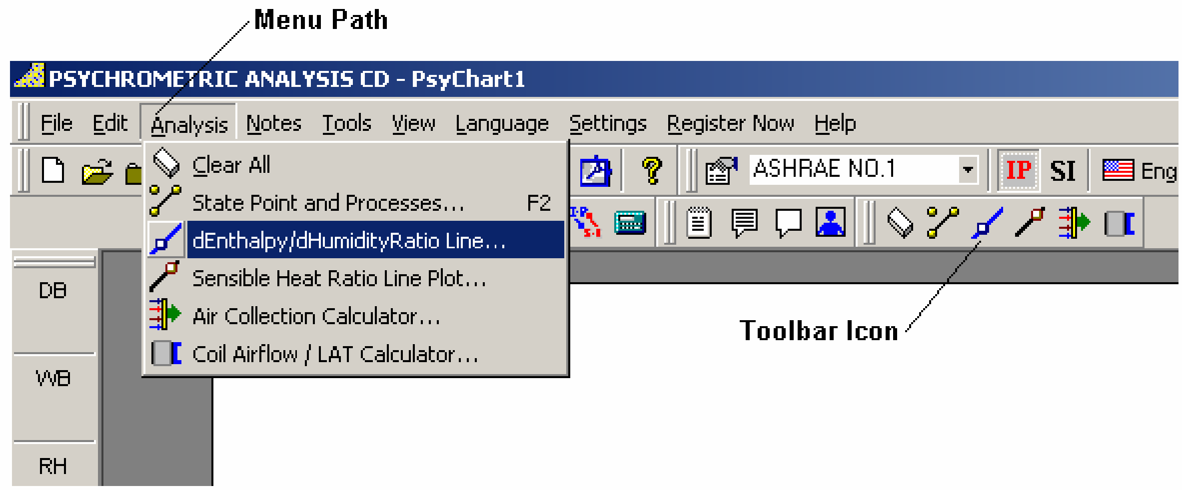
5. Click the “Plot SHR Line” and the SHR Line is automatically plotted across the chart.



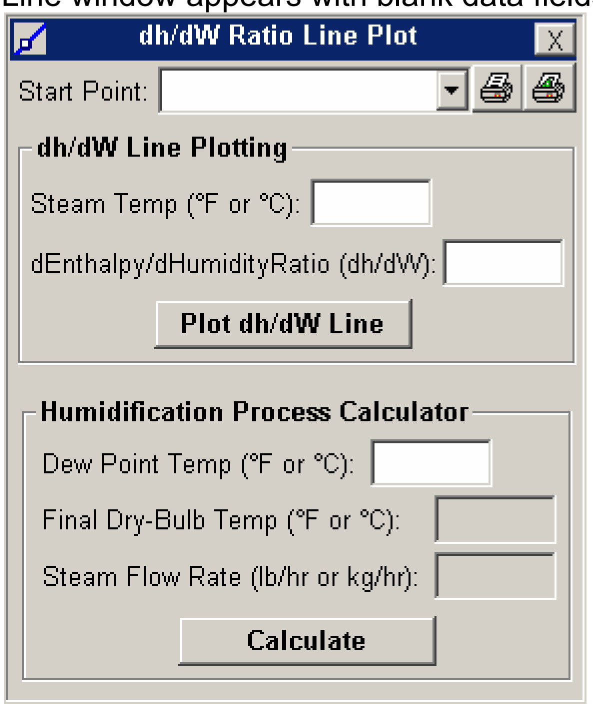
DELTA-h / DELTA-W LINE PLOTTING

1. NOTE: You need to have at least ONE point created BEFORE calculation of a constant delta-h / delta-W line can be performed.

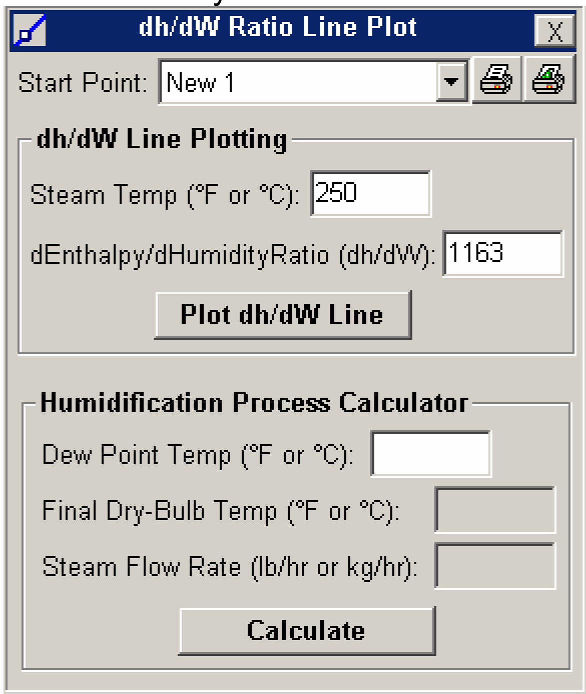
2. Activate "Delta-h / Delta-W Line Plot" by either of the two methods shown below:



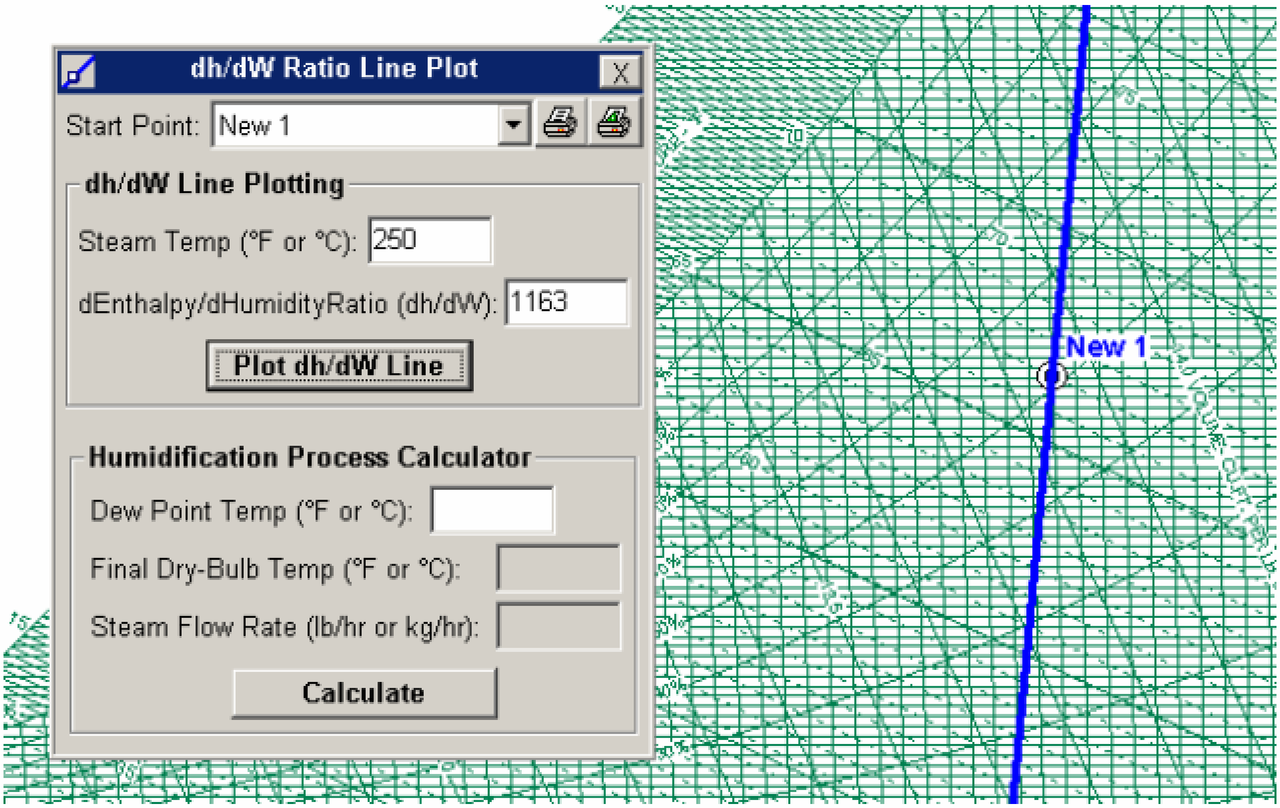
3. The Delta-h / Delta-W Line window appears with blank data fields.



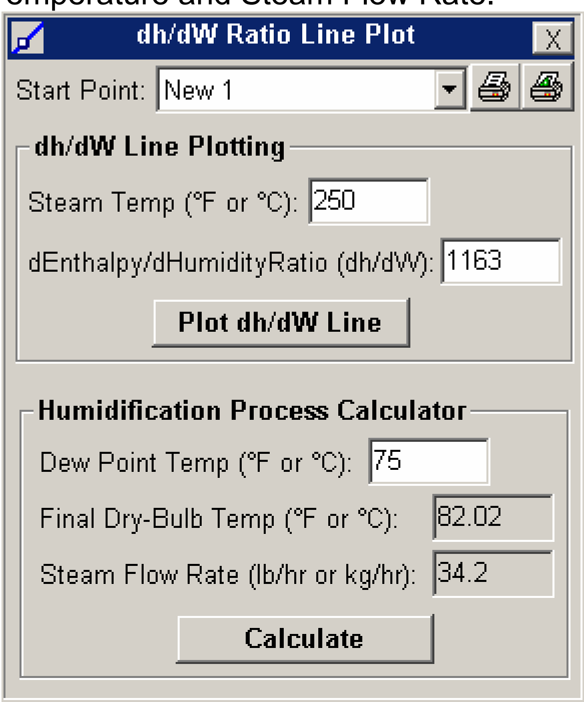
4. Click the Start Point combo box drop-down to select the desired reference point and enter the “Steam Temperature” or “dh/dW” values in the space provided. Please note that which ever value isn’t provided, is automatically calculated real-time.



5. Click the “Plot dh/dW Line” and the Delta-h/Delta-W Line is automatically plotted across the chart.



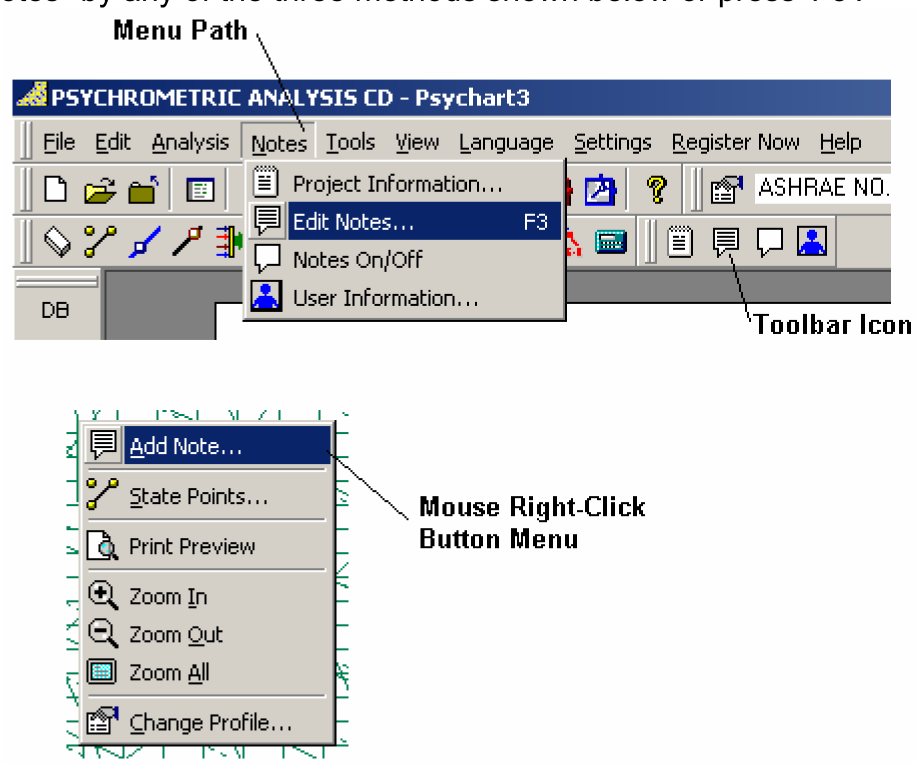
6. Type the desired final Dew Point Temperature and click the “Calculate” button to see the resulting Final Dry-Bulb Temperature and Steam Flow Rate.



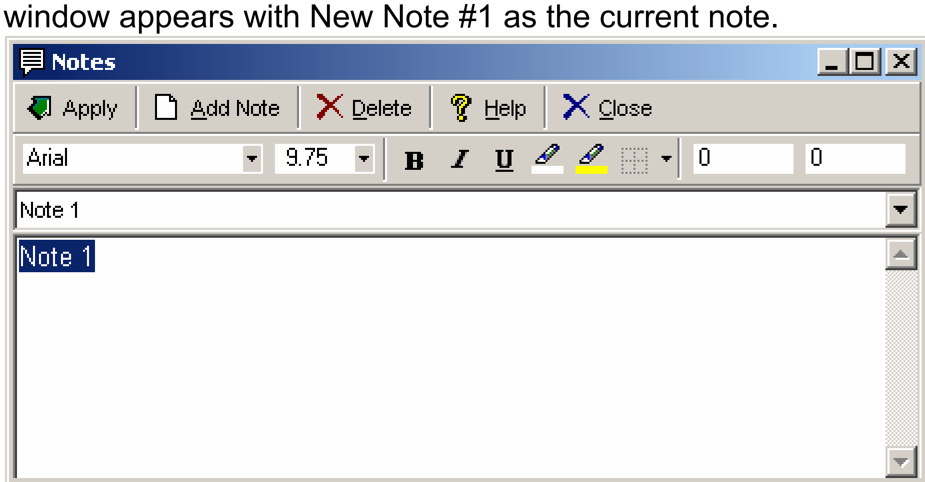
NOTE CONTROLS

CHART NOTES

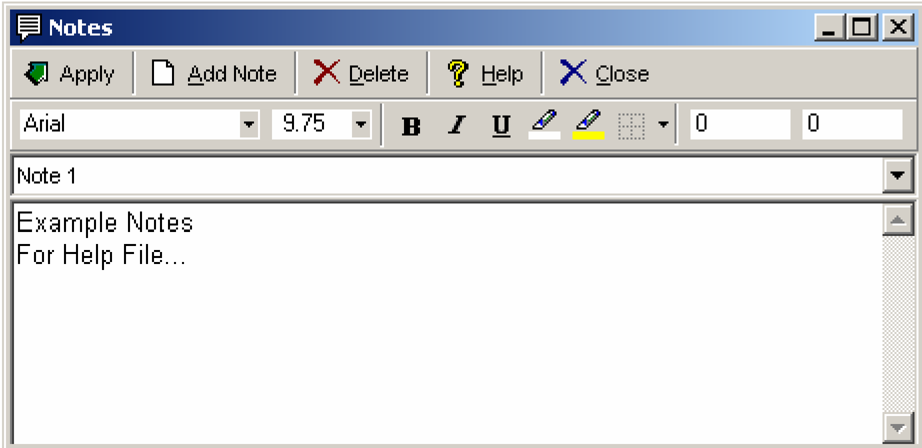
1. Activate "Notes" by any of the three methods shown below or press 'F3':



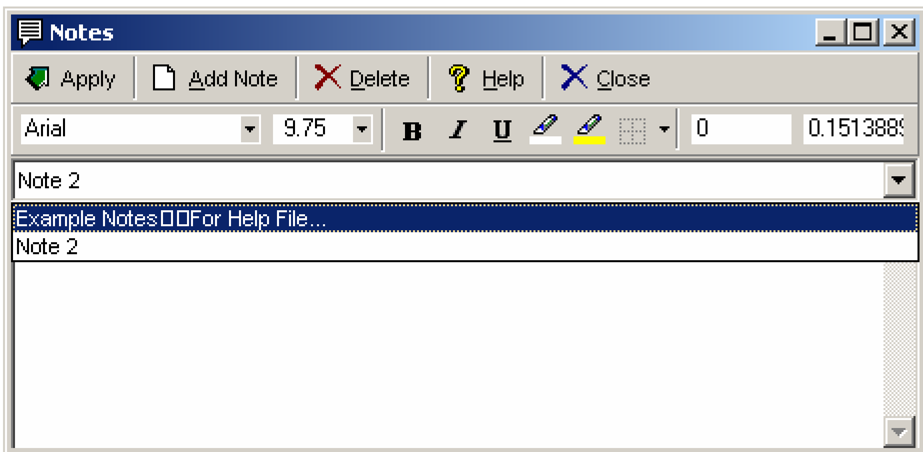
2. The Notes window appears with New Note #1 as the current note.



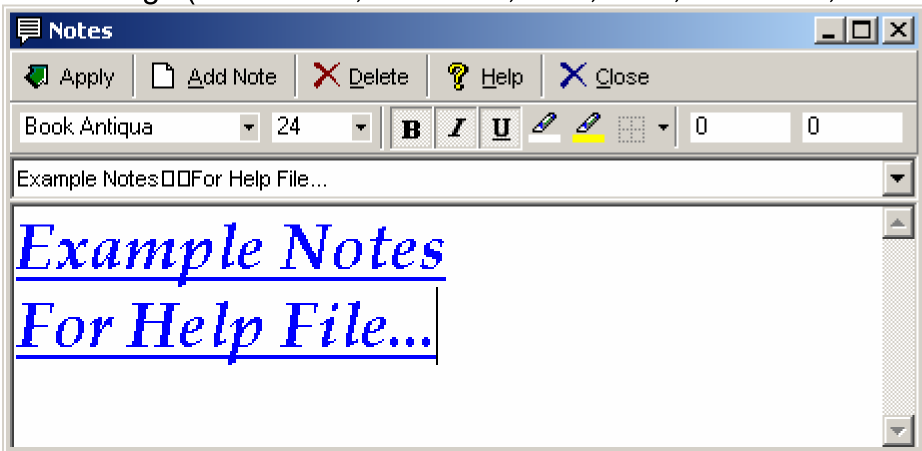
3. To create a new note, enter the desired note text in the "Note Text" field.



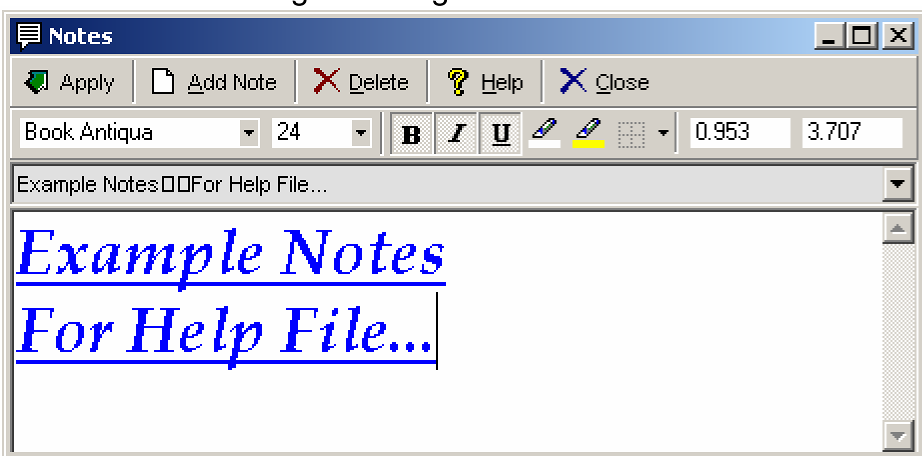
4. To edit an existing note, click the "Selected Note Name" drop-down and select the desired existing Note to be edited from the list. Enter the "Note Text" field to make any text revisions.



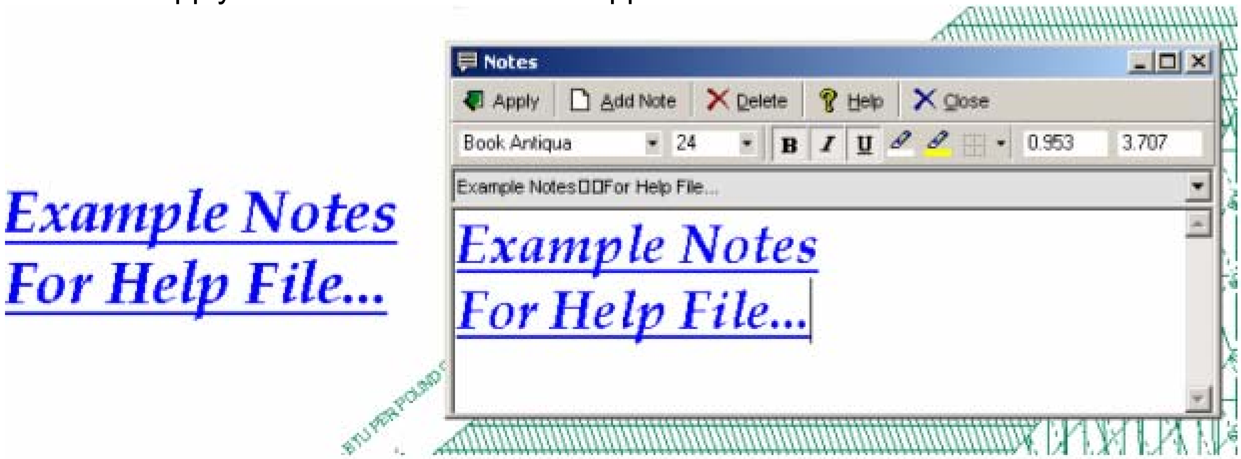
5. Adjust the font settings (Font Name, Font Size, Bold, Italic, Underline, Color) as desired.



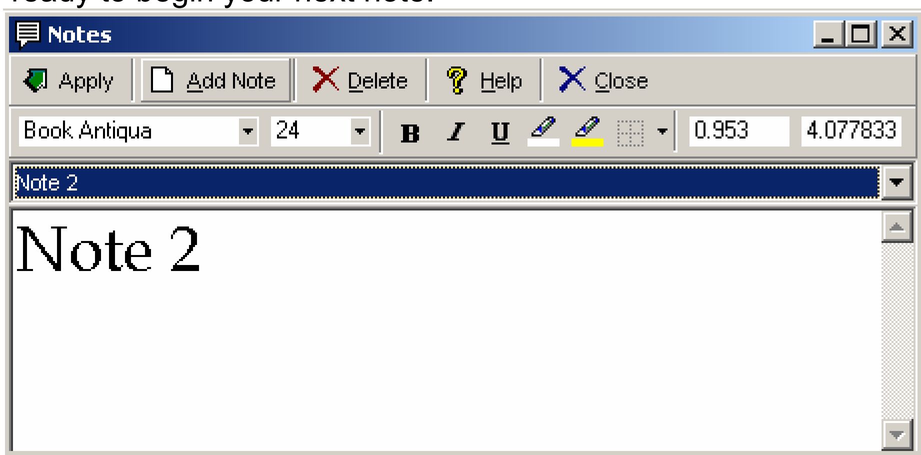
6. Enter the Note X & Y location by either typing the X & Y coordinates in to the appropriate fields or use the left mouse button and click once on the chart, move the mouse to see the coordinates track the mouse location and when the mouse is at the desired location, perform a left mouse button single click again to set the coordinates. See Above graphic.



7. Click the "Apply" button and the note will appear on the chart:



8. The Note window remains open. To add additional notes, simply click the "New" button and you’re ready to begin your next note.



9. Psychrometric Analysis allows an unlimited amount of notes to be entered. Each note can have its own properties. All information is saved to the project file. The Notes window accepts the information you want to place on the chart, allows font changes and provides a means to position the information.

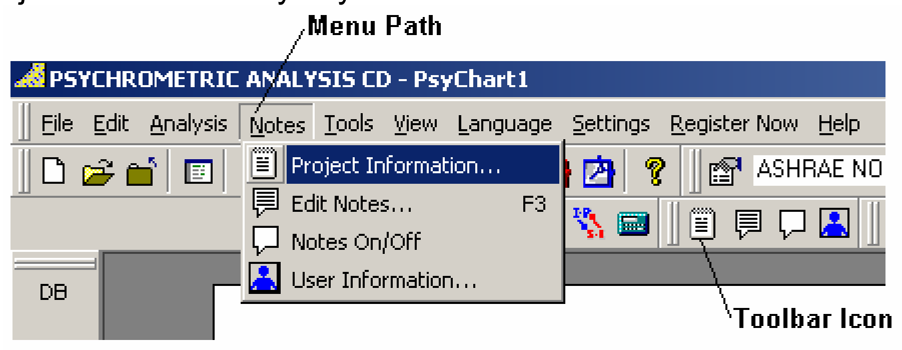
10. Enter your notes in the text box. Use any of the font buttons to adjust the settings. Set the position by clicking on the chart or using the X and Y position settings provided in text box. Now click "Apply" to add the project information to the chart.

11. You may want to change the position of the information on the chart after you see it. While the Notes window is open you may do so by making a single click on the information and then another single click at the new location. To edit the information, make the changes in the Notes window and click "Apply".

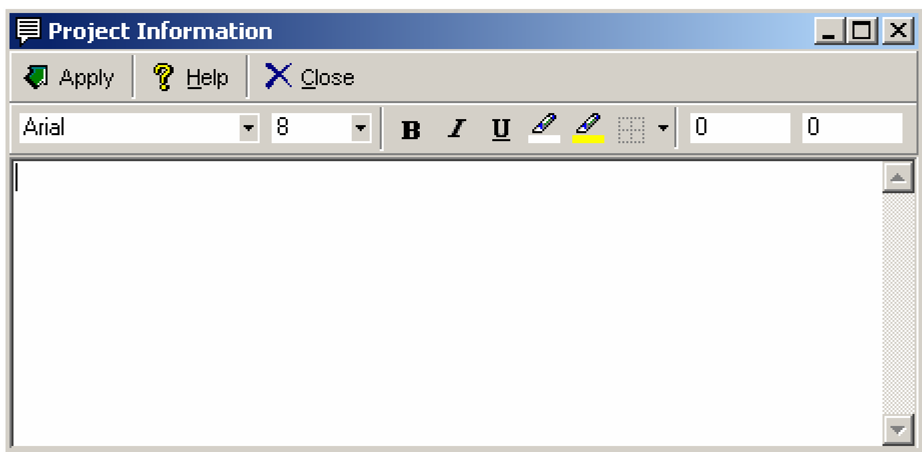
12. You may edit this information, change its font or position at any time. Simply open the Notes window and make the changes.

PROJECT INFORMATION NOTE

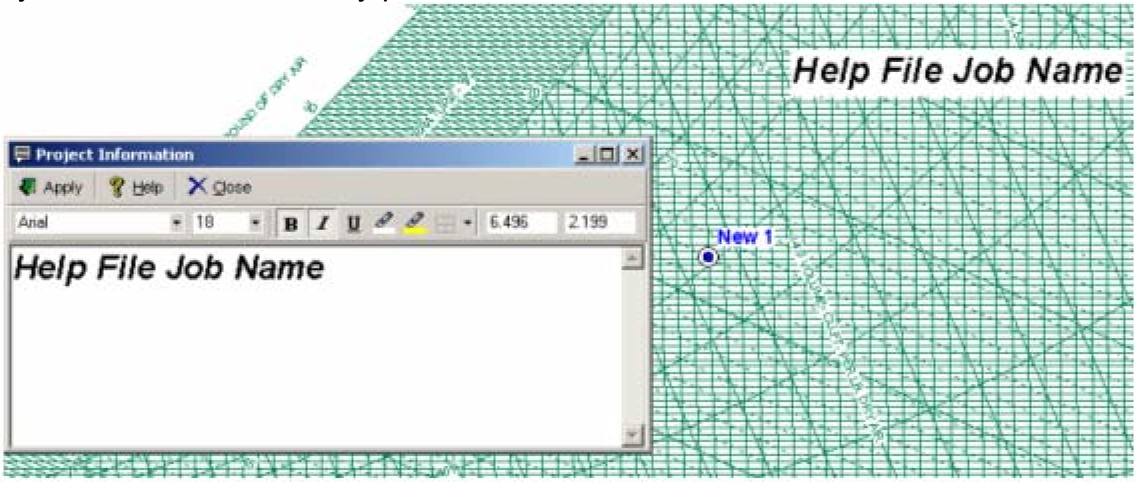
1. Activate "Project Information" by any of the two methods shown below.



2. The Project Information window appears ready to receive the Project Name as the current note. Please note that this note will appear on the state point reports as the Project Name.

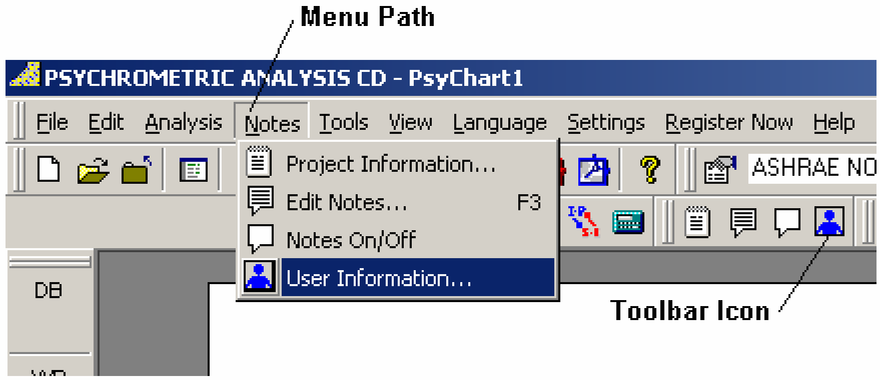


3. Type in the project name you wish, adjust fonts, location, etc. When finished, click the "Apply" button to automatically place on the chart.

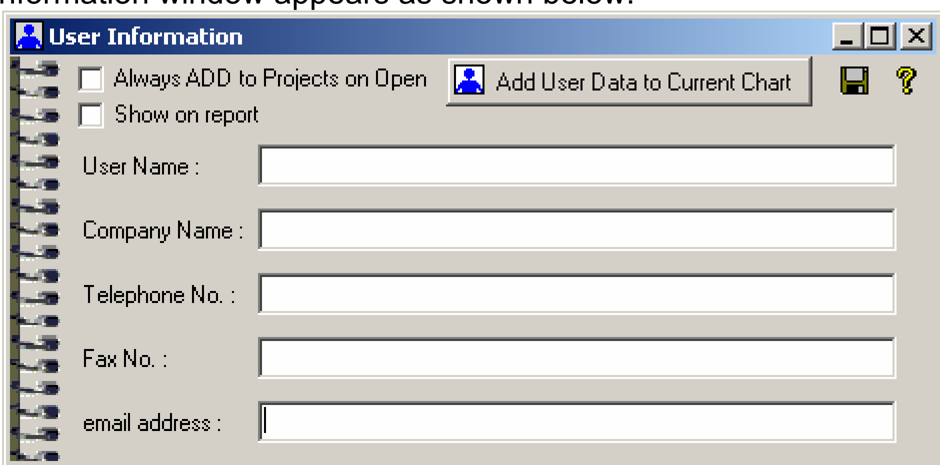


USER INFORMATION NOTE

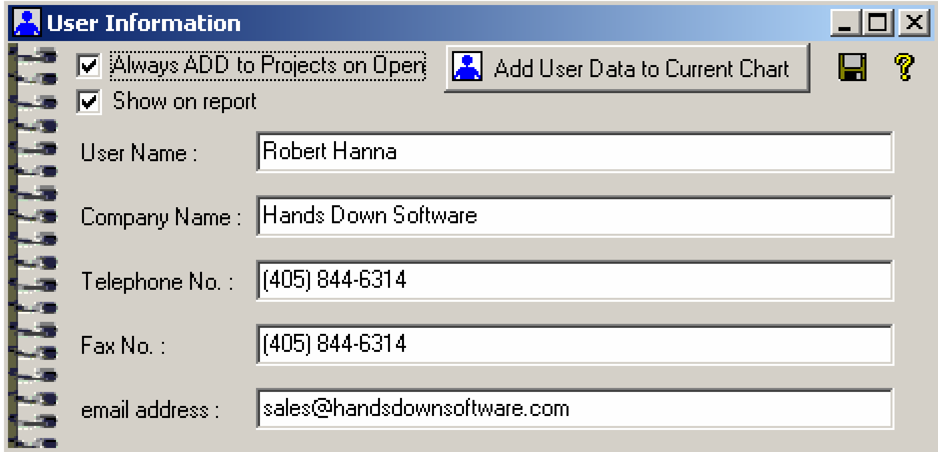
1. Activate "User Information" by either of the two methods shown below.



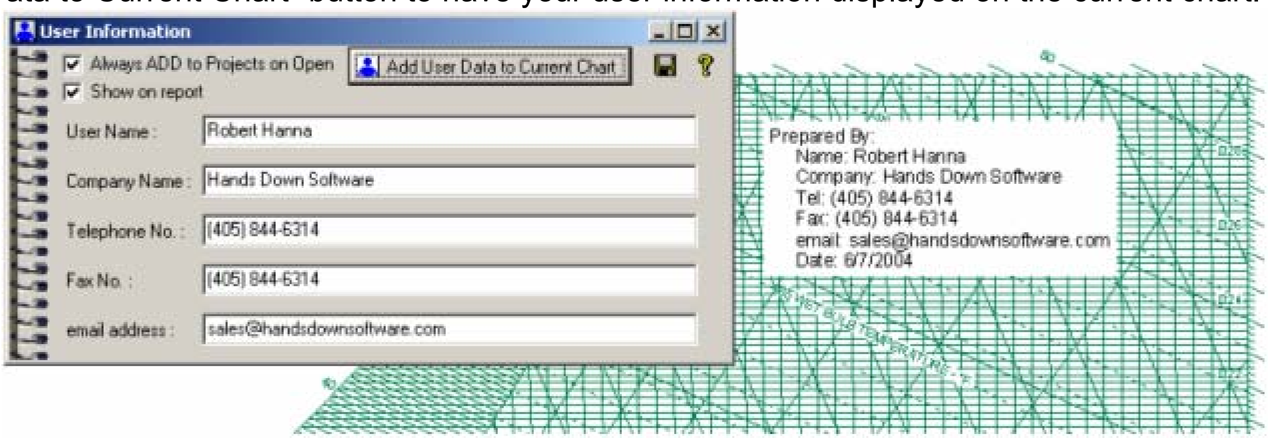
2. The User Information window appears as shown below:



3. Type in your information in the space providing. Check the display options you wish to choose for your default.

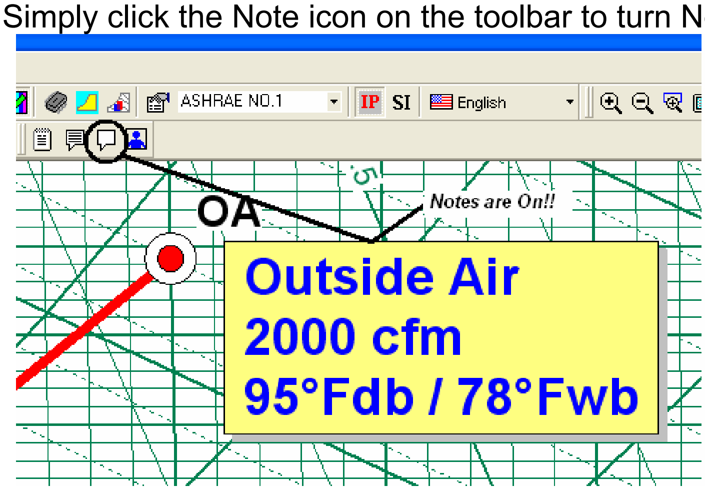


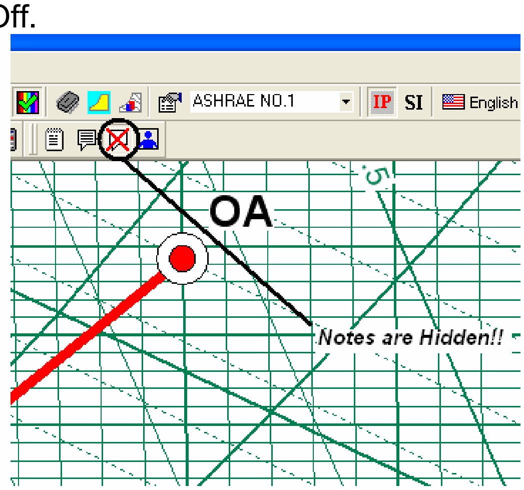
4. Click the “Save” button in the upper right hand corner. You may also click the “Add User Data to Current Chart” button to have your user information displayed on the current chart.



NOTE ON/OFF CONTROL

Simply click the Note icon on the toolbar to turn Notes On/Off.





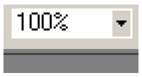
VIEW CONTROLS

ZOOMING AND PANNING

Zoom IN

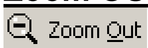


1. Click View on the menu bar, then click the Zoom In icon.
2. Click the Zoom In icon on the toolbar.
3. Enter the Zoom Percent into the zoom factor dropdown on the toolbar.

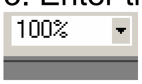


4. Move your mouse so the cursor is on the chart and **Double-Click the LEFT mouse button**.

Zoom OUT



1. Click View on the menu bar, then click the Zoom Out icon.
2. Click the Zoom Out icon on the toolbar.
3. Enter the Zoom Percent into the zoom factor dropdown on the toolbar.

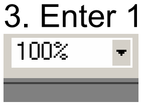


4. Move your mouse so the cursor is on the chart and **Double-Click the RIGHT mouse button**.

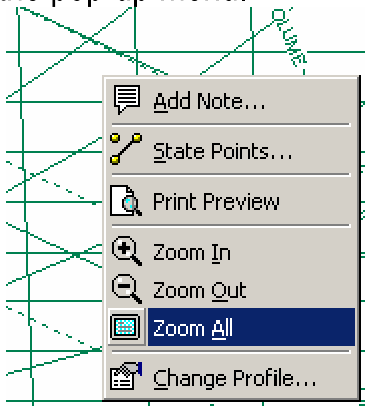
Zoom ALL



1. Click View on the menu bar, then click the Zoom All icon.
2. Click the Zoom All icon on the toolbar.
3. Enter 100 into the zoom factor dropdown on the toolbar.

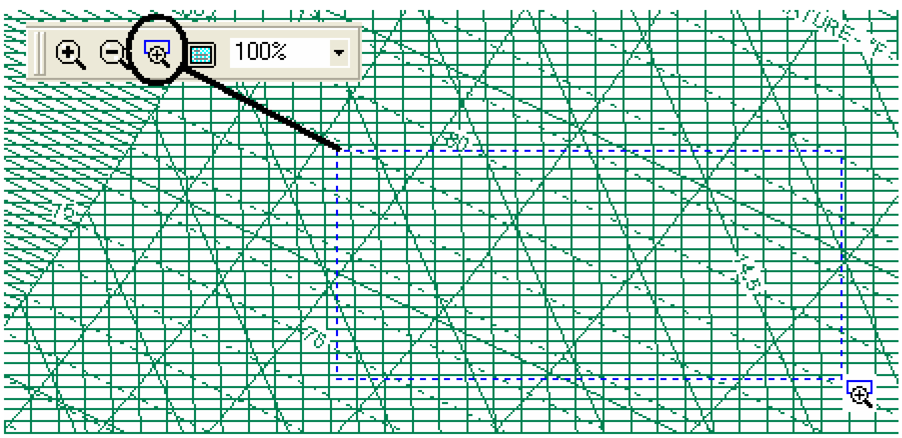


<u>Zoom MENU</u>
1. Move your mouse so the cursor is on the chart and **Single-Click** the **RIGHT** mouse button and click the Zoom action icon on the pop-up menu.



<u>Panning</u>
If you are **<u>ZOOMED IN</u>** on the chart, simply position your mouse on the chart and **<u>hold the LEFT mouse button down and move your mouse</u>**. When you have panned to the desired position, release the left mouse button.

<u>Zoom WINDOW</u>
Simply click the Zoom Window icon on the tool bar, then click the first corner of the window on the chart, move the mouse and click the other window corner.

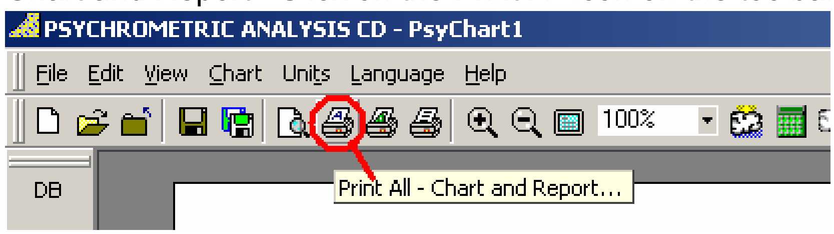


REPORTS

PRINT ALL

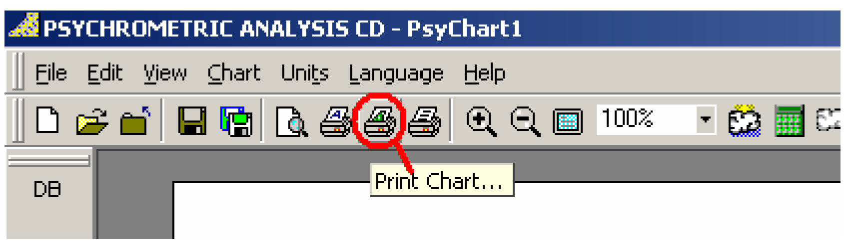
There are four different choices when printing:

1. Print BOTH the Chart and Report. Click on the Print All icon on the toolbar.



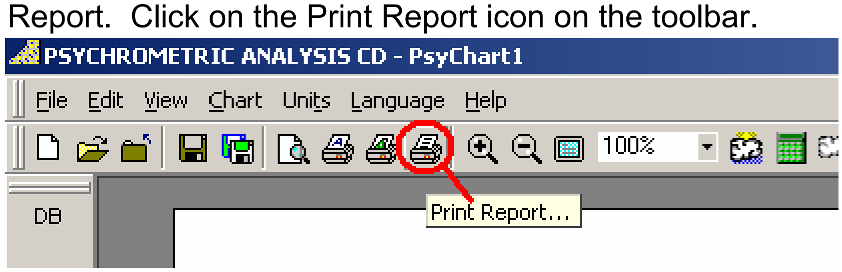
PRINT CHART

2. Print ONLY the Chart. Click on the Print Chart icon on the toolbar.

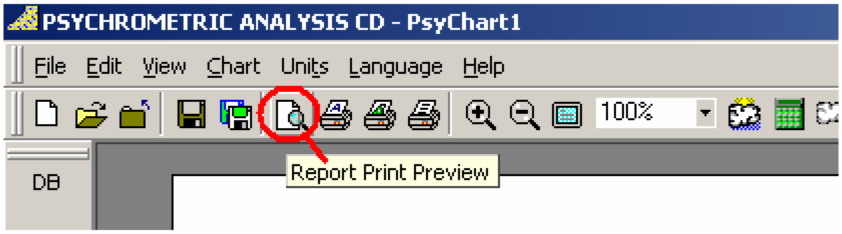


PRINT REPORT

3. Print ONLY the Report. Click on the Print Report icon on the toolbar.

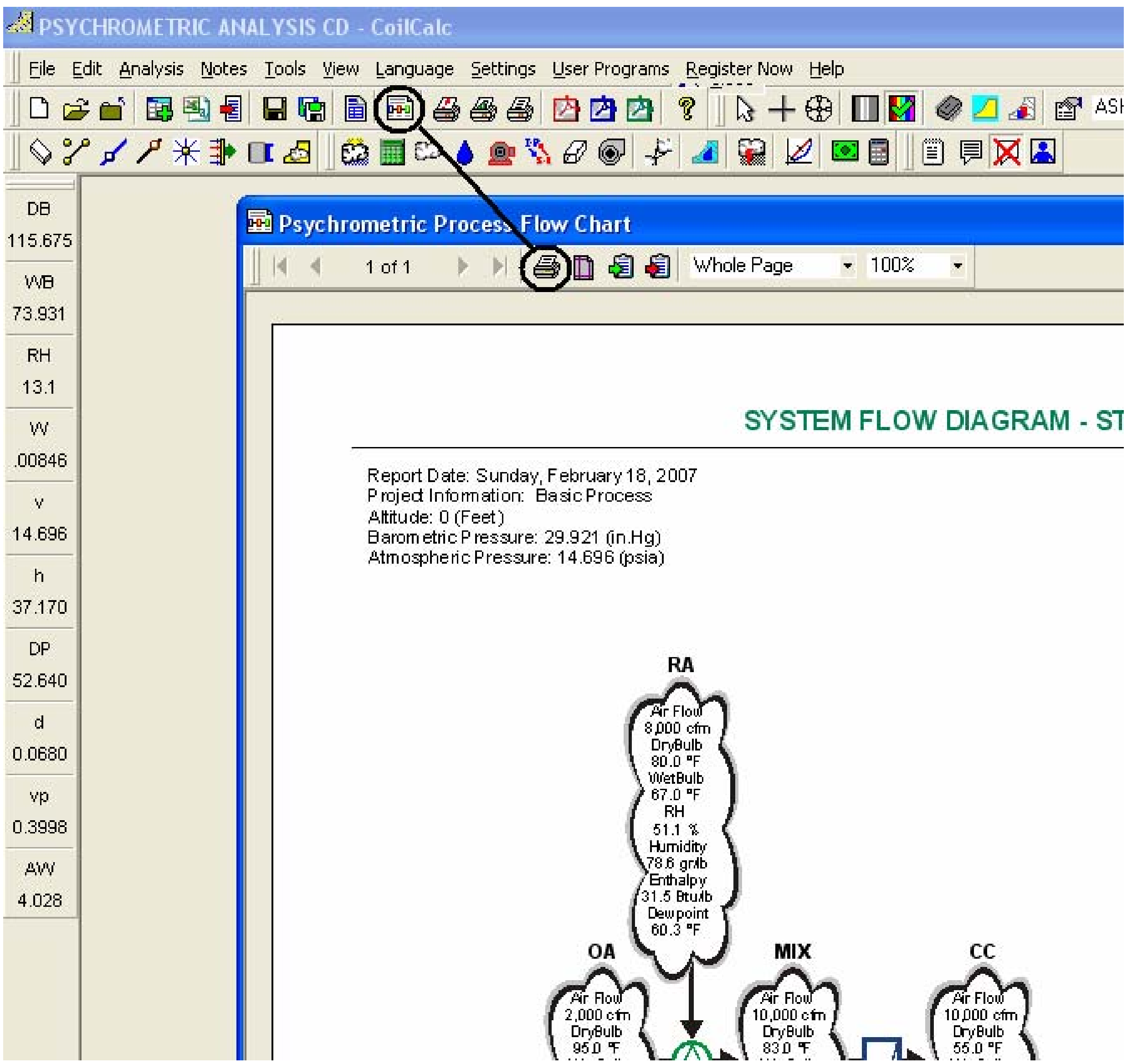


4. Print Preview ONLY the Report. Click on the Report Print Preview icon on the toolbar.



PRINT FLOWCHART

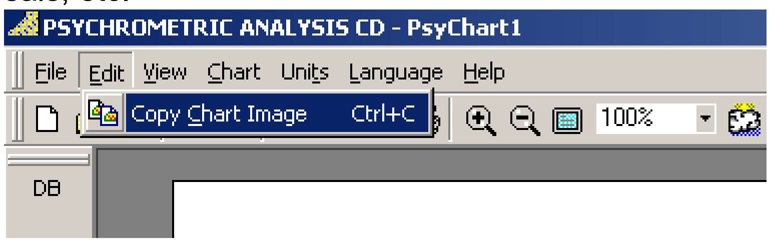
Click the FlowChart icon on the toolbar, and then click the print icon on the flowchart window to print the flowchart.



DATA EXCHANGE

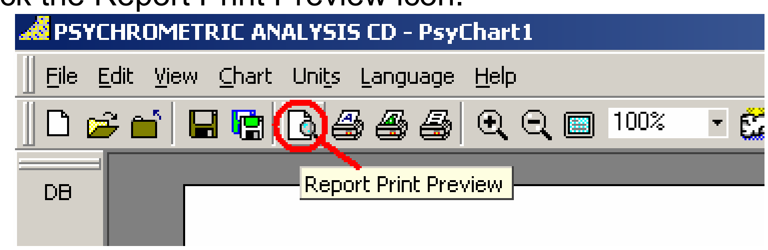
EXPORT/COPY CHART

From the menu, click on Edit, and then click Copy Chart Image. The psychrometric chart image is automatically placed on your clipboard for you to paste into your reports, presentations, proposals, etc.

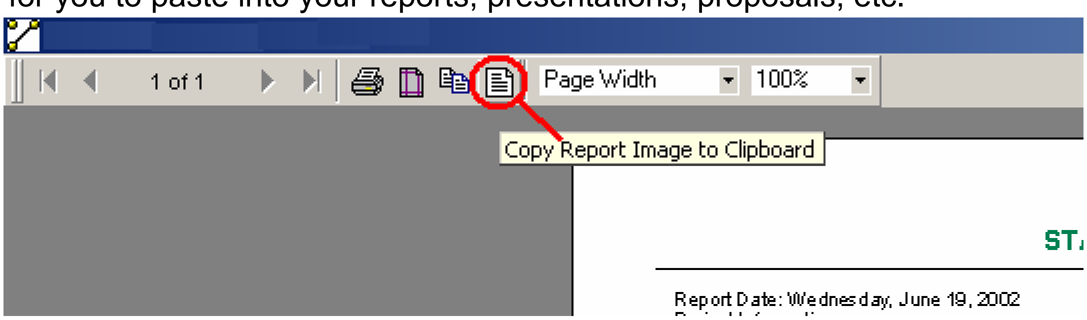


EXPORT/COPY REPORT

From the toolbar, click the Report Print Preview icon.

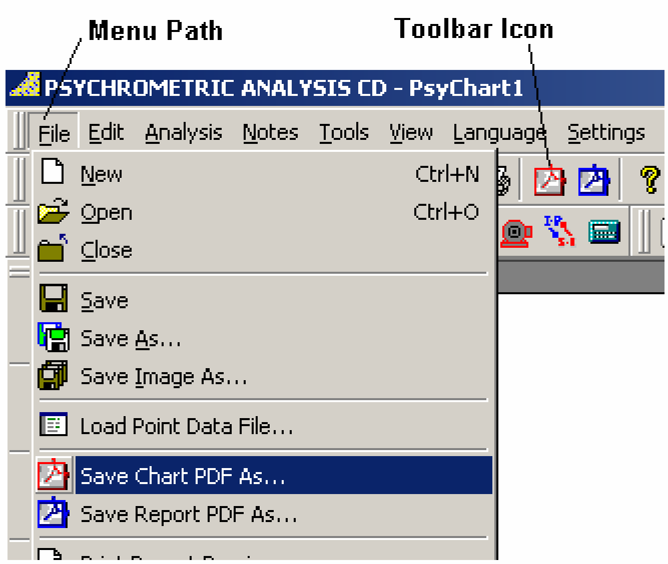


Then from the toolbar on the Report Print Preview, click the Copy Report Data to Clipboard icon. The complete state-point and process report image is automatically placed on your clipboard for you to paste into your reports, presentations, proposals, etc.

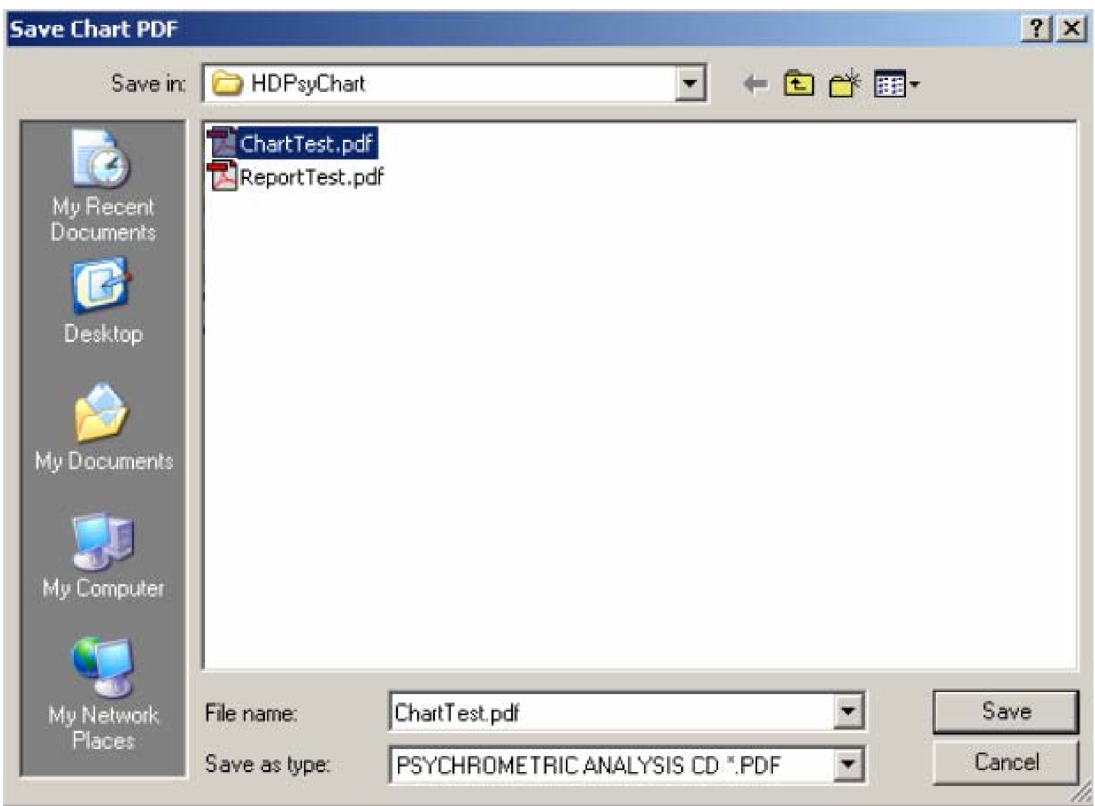


EXPORT/CREATE CHART PDF

1. Activate "Save Chart PDF As…" by either of the two methods shown below:

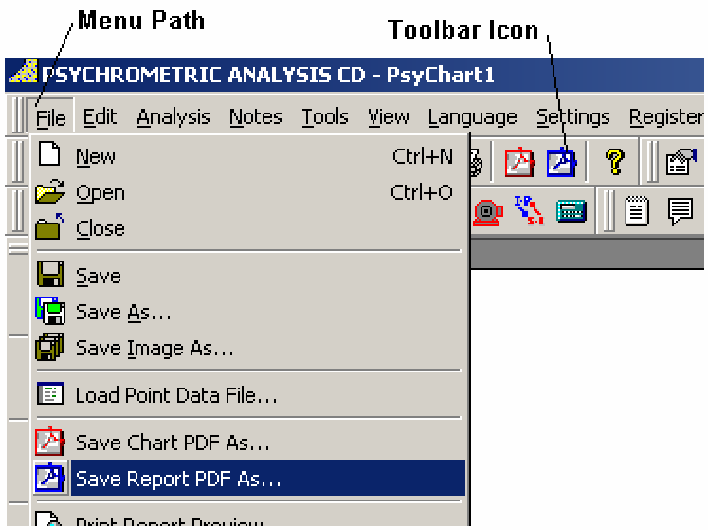


2. Navigate to where you want to save the file, type in the file name and click the “Save” button.

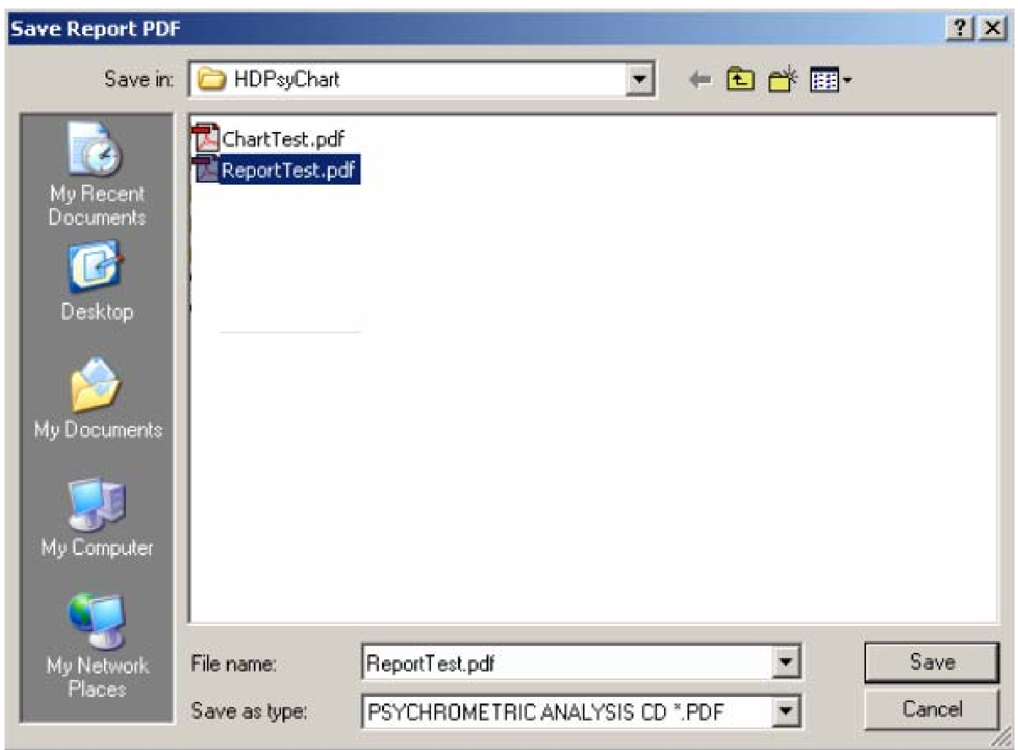


EXPORT/COPY REPORT PDF

1. Activate "Save Report PDF As…" by either of the two methods shown below:

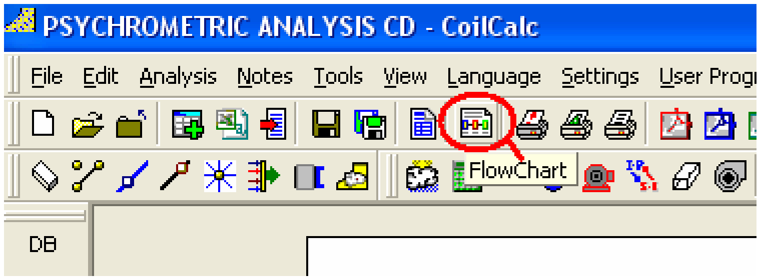


2. Navigate to where you want to save the file, type in the file name and click the “Save” button.

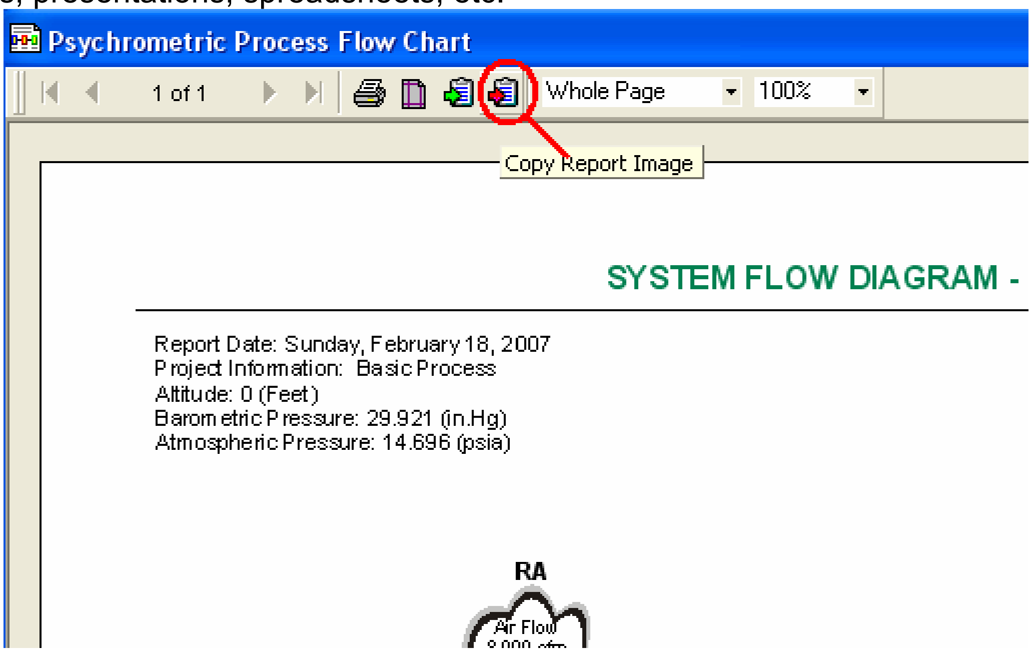


EXPORT/COPY FLOWCHART

From the toolbar, click the Flow Chart icon.

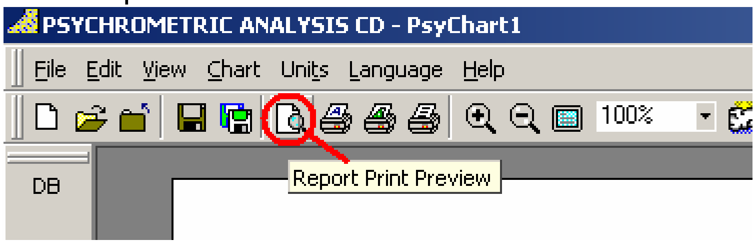


Then from the toolbar on the Flow Chart, click the Copy Report Image to Clipboard icon. The complete flow chart report image is automatically placed on your clipboard for you to paste into your reports, presentations, spreadsheets, etc.

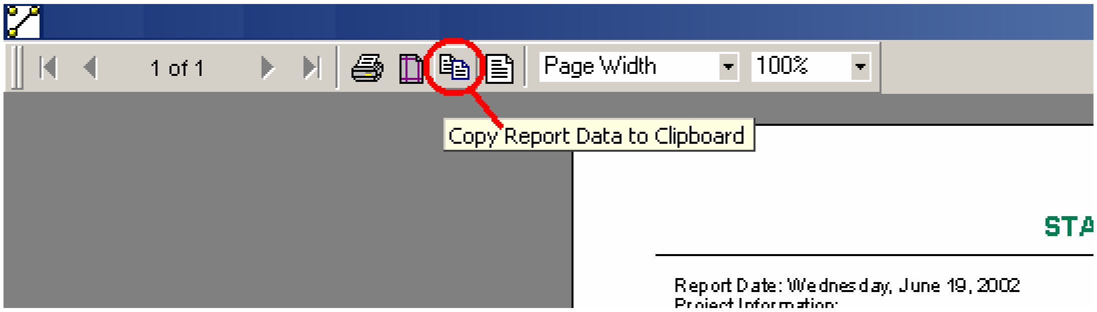


EXPORT/COPY REPORT DATA

From the toolbar, click the Report Print Preview icon.

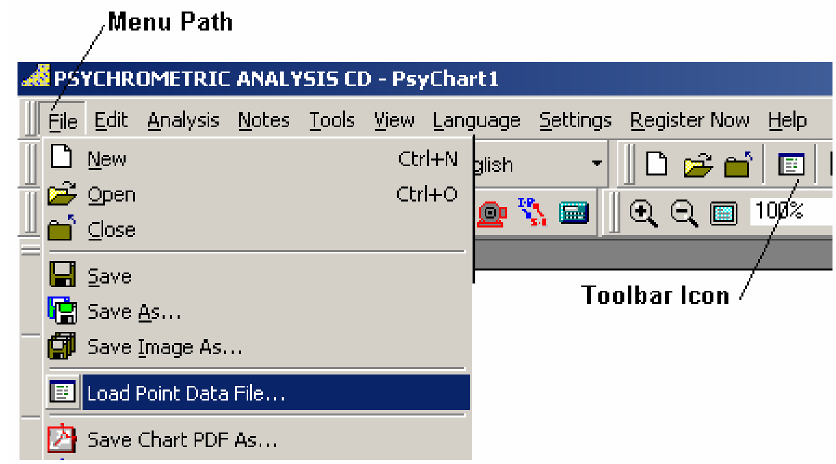


Then from the toolbar on the Report Print Preview, click the Copy Report Data to Clipboard icon. The complete state-point and process report data is automatically placed on your clipboard for you to paste into your reports, presentations, spreadsheets, etc.

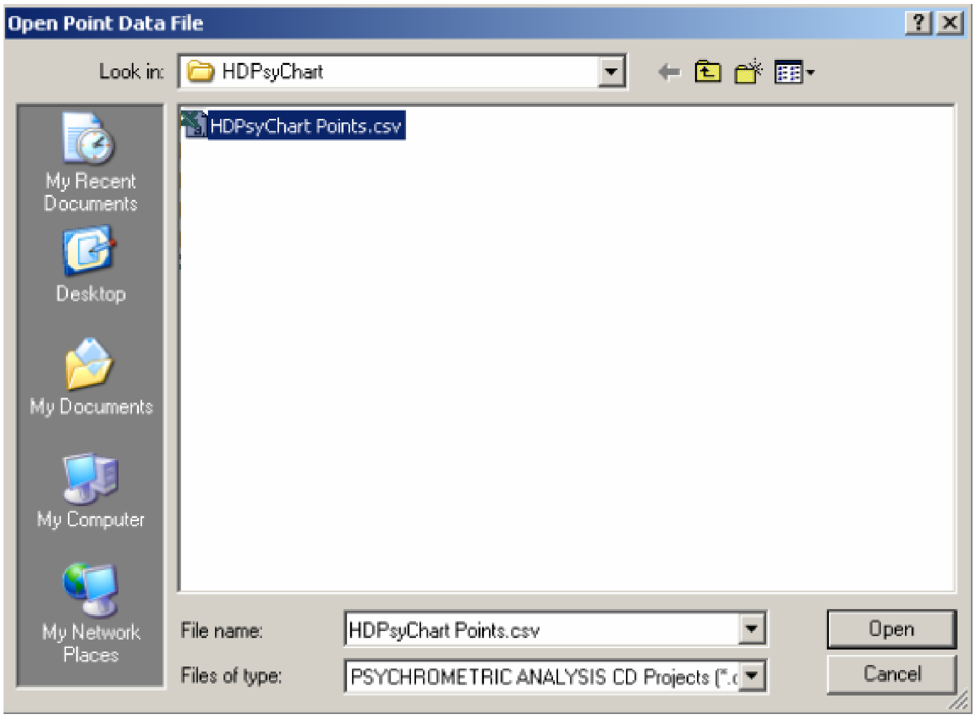


IMPORTING DATA

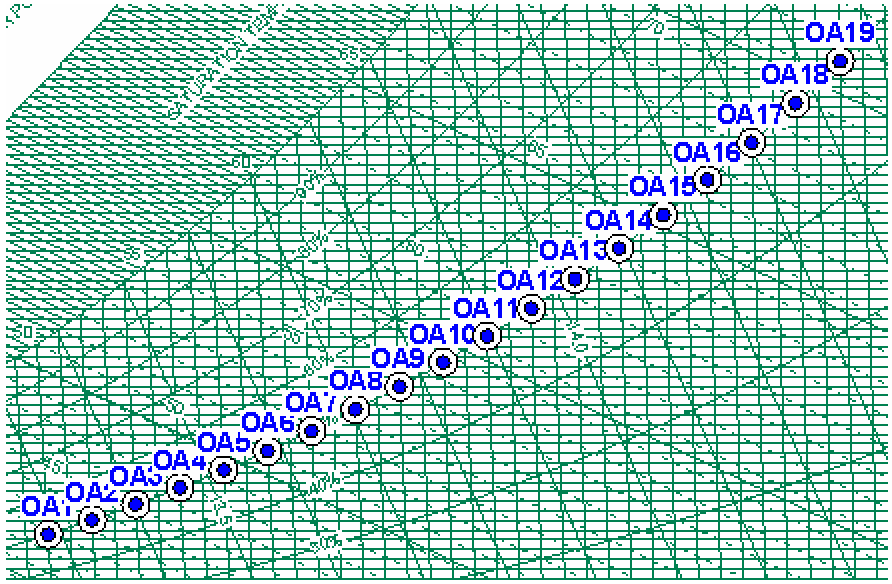
From the toolbar, click the Import Data File icon.



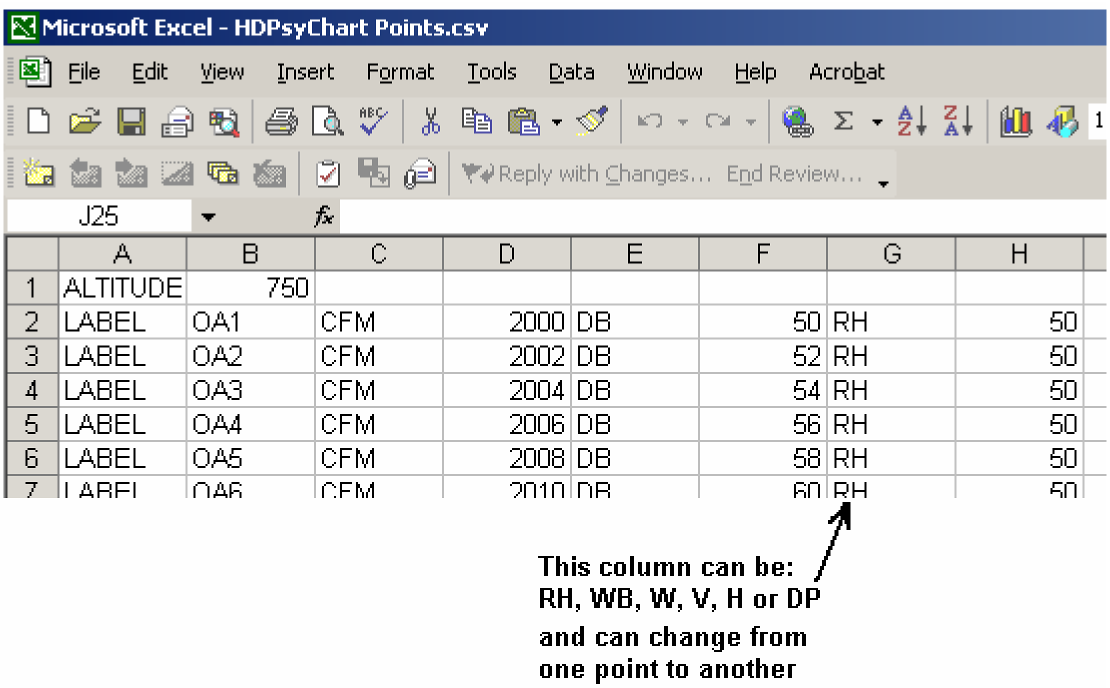
Then navigate to the ".csv" file with the data you wish to import. ".csv" file format is a comma delimited file format, which is an export option for spreadsheet programs such as Microsoft Excel.



Then Click the "Open" button and the data points will be imported and displayed on the chart. Below is an example shipped with this program:

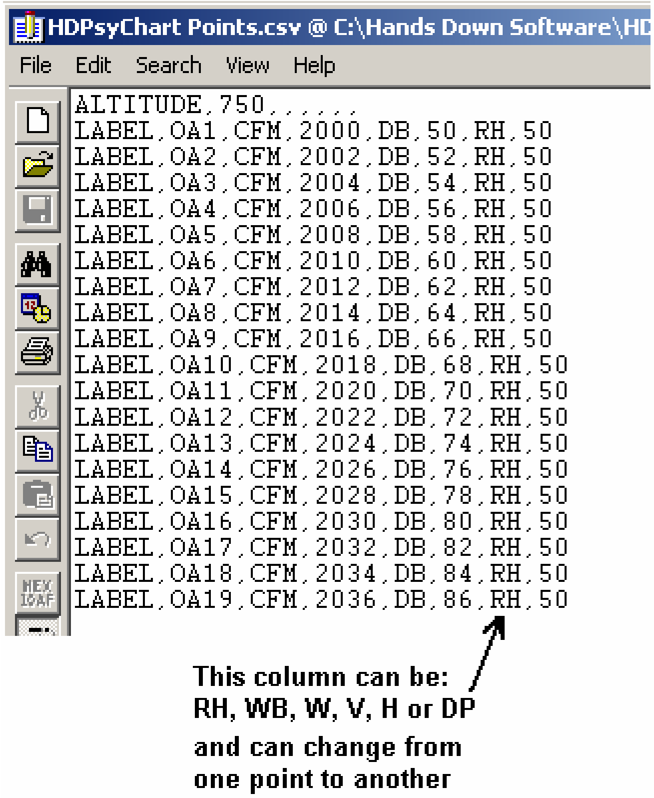


If using a Spreadsheet to create the ".csv" file, data points must be set up with the following structure:



	A	B	C	D	E	F	G	H
1	ALTITUDE	750						
2	LABEL	OA1	CFM	2000	DB	50	RH	50
3	LABEL	OA2	CFM	2002	DB	52	RH	50
4	LABEL	OA3	CFM	2004	DB	54	RH	50
5	LABEL	OA4	CFM	2006	DB	56	RH	50
6	LABEL	OA5	CFM	2008	DB	58	RH	50
7	LABEL	OA6	CFM	2010	DB	60	RH	50

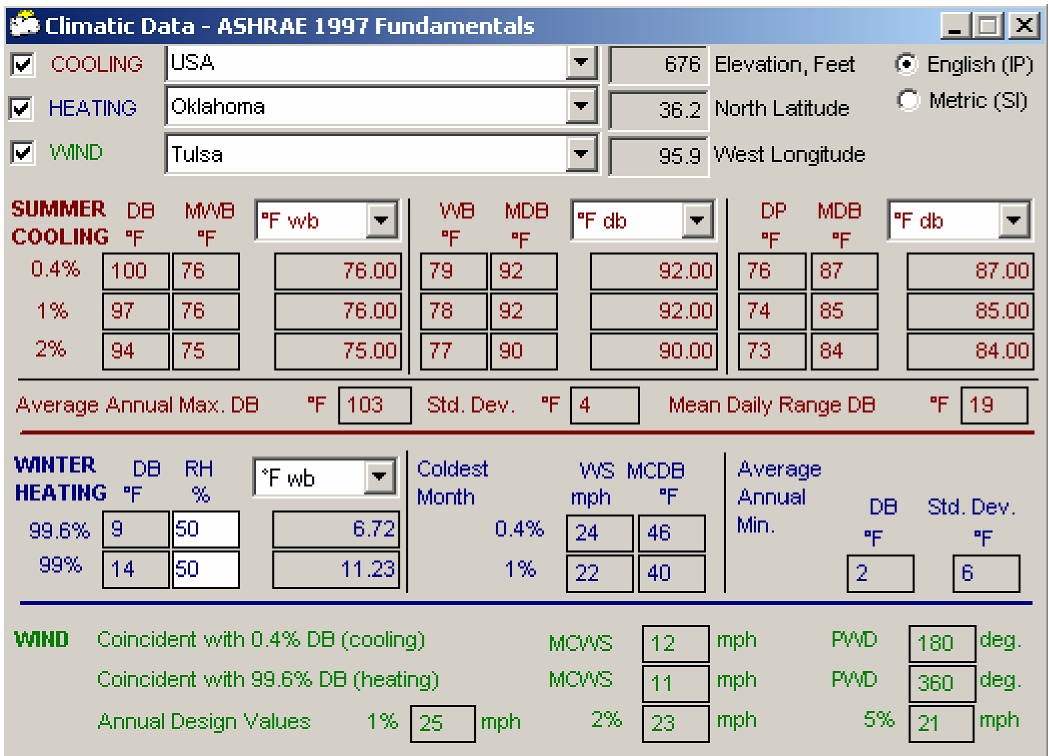
If using a text editor to create the ".csv" file, data points must be set up with the following structure:



TOOLBOX PROGRAMS

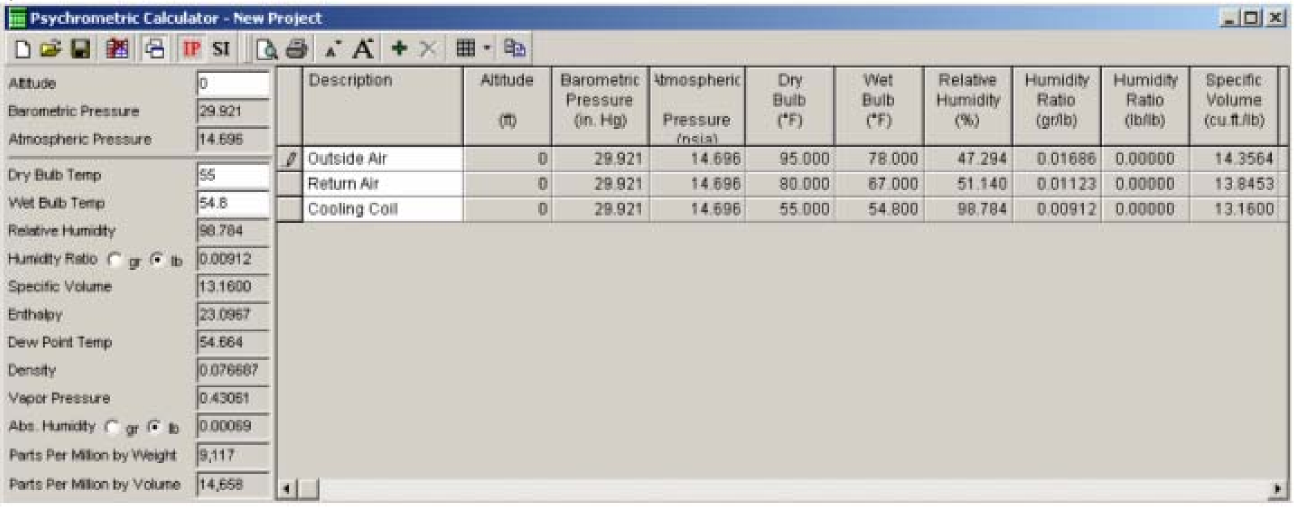
CLIMATIC DATA

Climatic Data provides ambient design conditions for over 1,000 locations in either IP or SI units of measure. Ambient data is from ASHRAE 1997 Fundamentals.

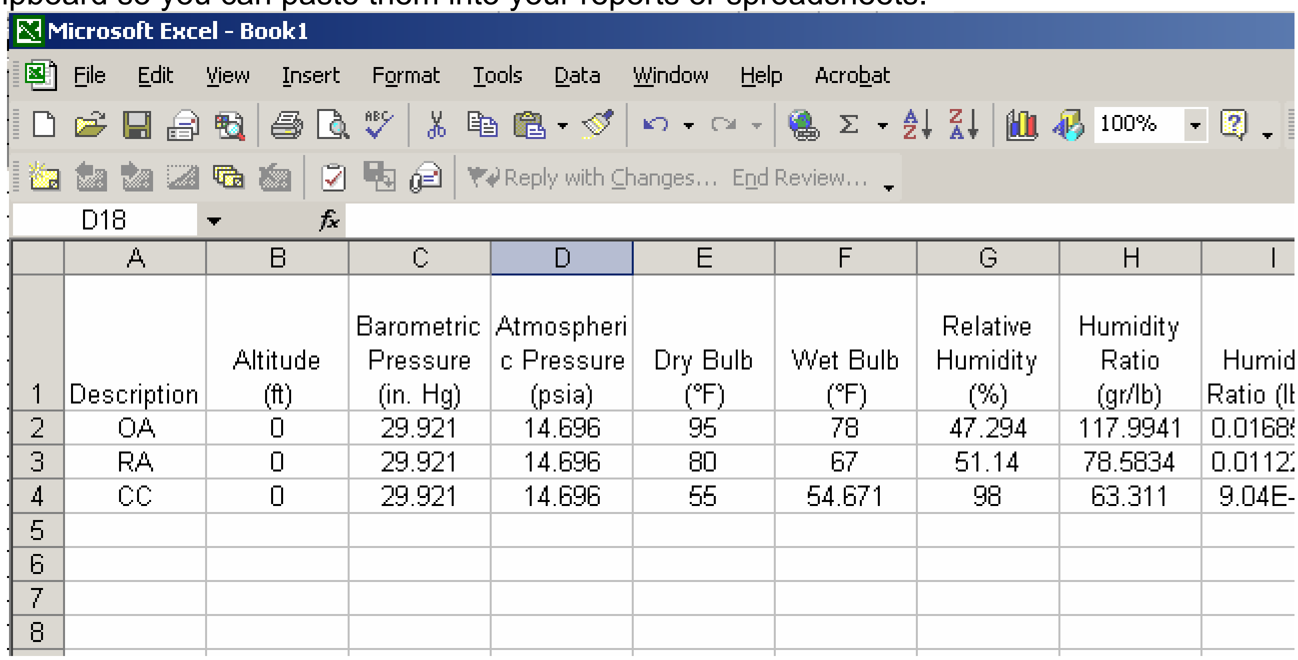


PSYCHROMETRIC CALCULATOR

Complete stand-alone psychrometric calculator is one of the tools provided. This psychrometric wonder has full File-Open-Save-SaveAs capabilities.

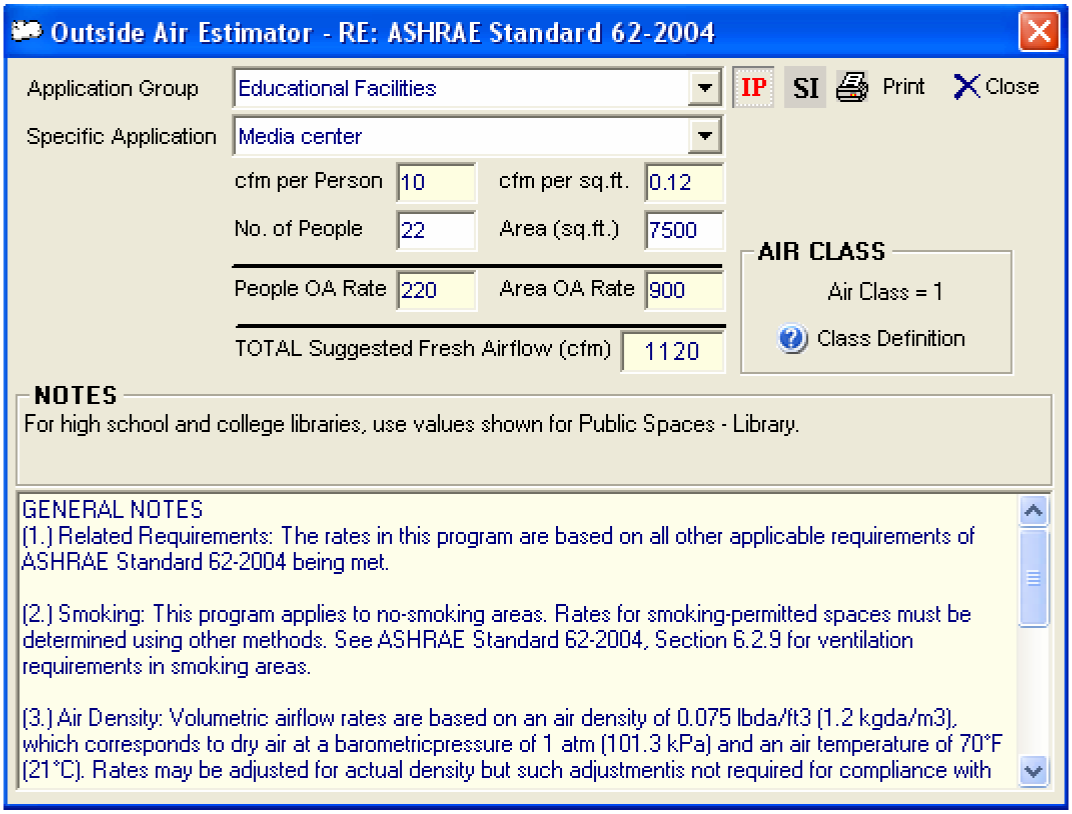


The program also has a data report for printing and the ability to copy all data points to the clipboard so you can paste them into your reports or spreadsheets.



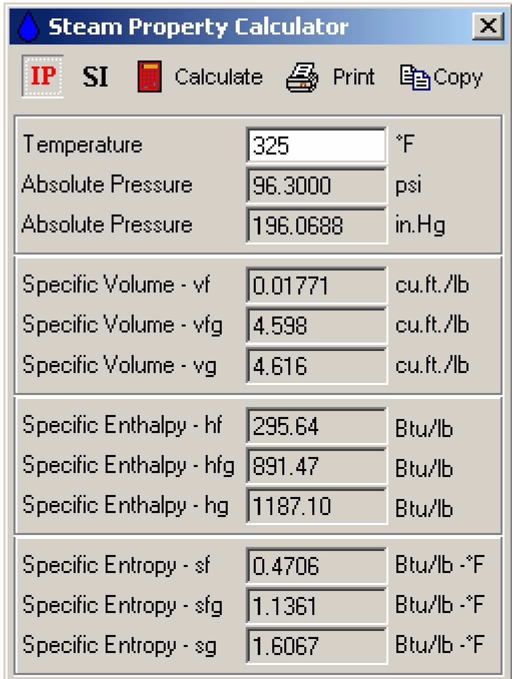
OUTSIDE AIR ESTIMATOR

Complete stand-alone fresh air estimator is one of the tools provided. This tool has many of the applications listed in ASHRAE Standard 62-2004.



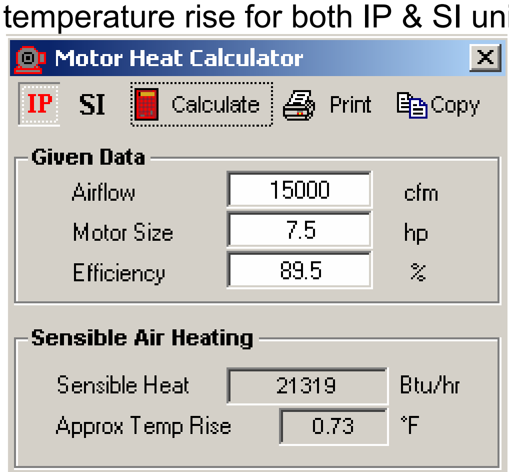
STEAM PROPERTY CALCULATOR

Complete steam property calculator is one of the tools provided. This tool provides complete thermo-physical properties of steam for both IP & SI units of measure.



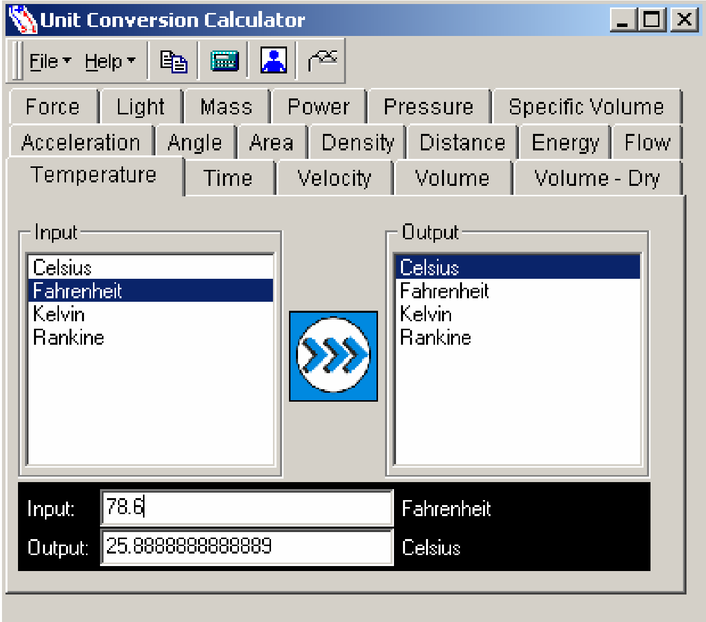
MOTOR HEAT CALCULATOR

Sensible Heat generated by motors in the air stream can now be easily calculated. This Motor Heat Calculator is one of the tools provided. Simply input three variables and click calculate. Calculates sensible heat and temperature rise for both IP & SI units of measure.



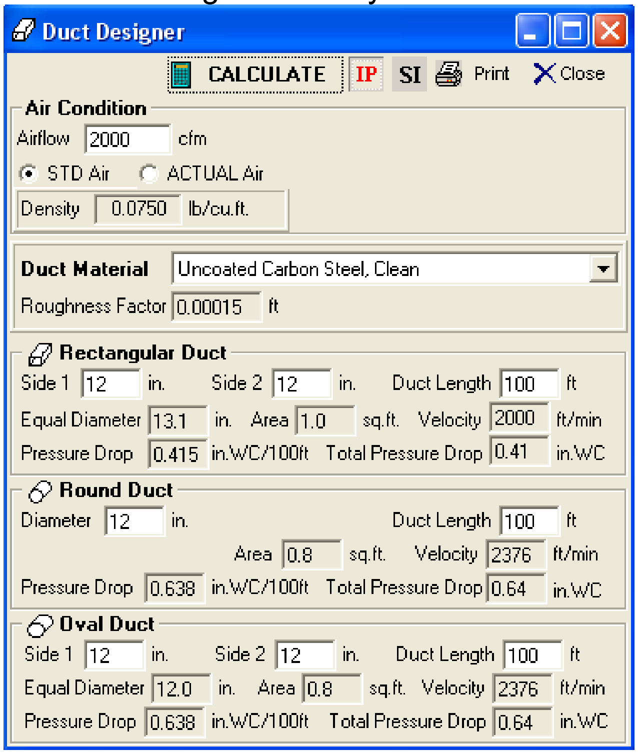
UNIT CONVERSION CALCULATOR

Unit of Measure converter is one of the tools provided. Simply click on the unit category and then click on the source and target units of measure and type in your value, resulting in real time conversion. This tool also allows the user complete Category Tab Management, unit of measurement management and conversion equation management.



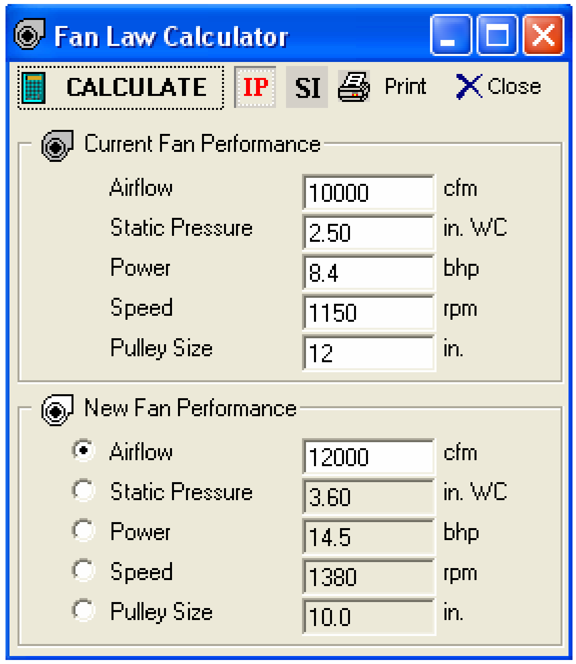
DUCT DESIGNER CALCULATOR

This Duct Designer tool aids in the design of duct system and associated pressure drops.



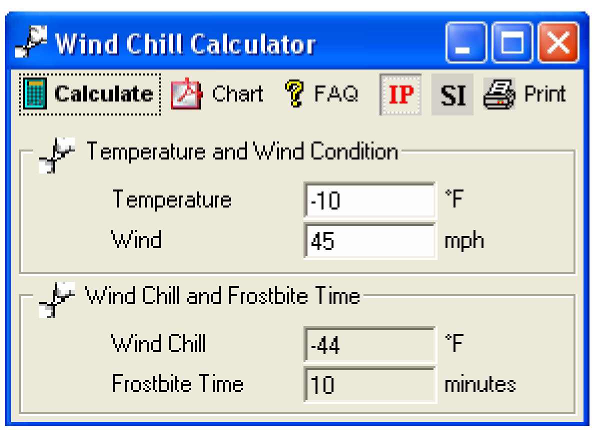
FAN LAW CALCULATOR

The Fan Law Calculator is a very useful tool for modeling “what-if” scenarios.



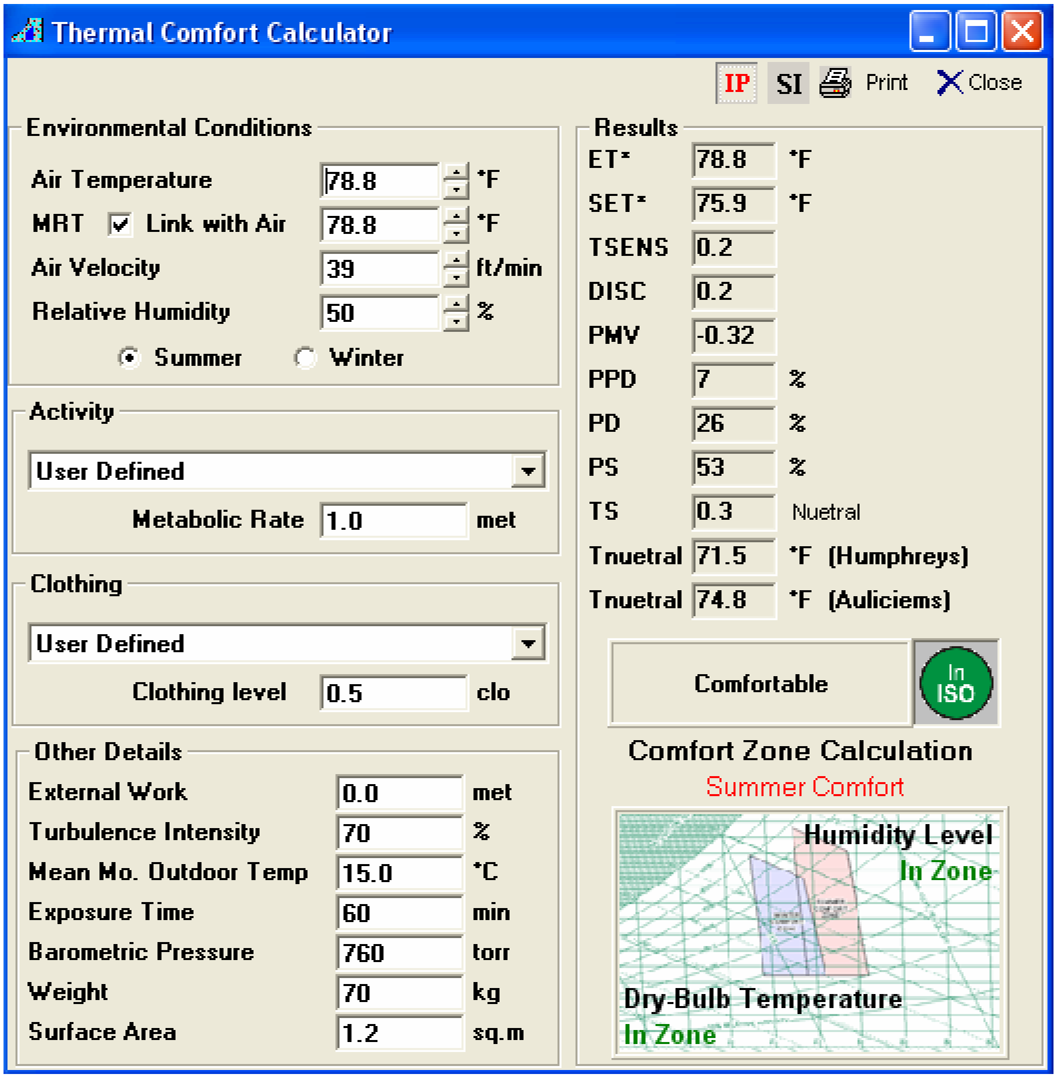
WIND CHILL CALCULATOR

This Wind Chill calculator is a useful tool when considering outdoor thermal comfort conditions.



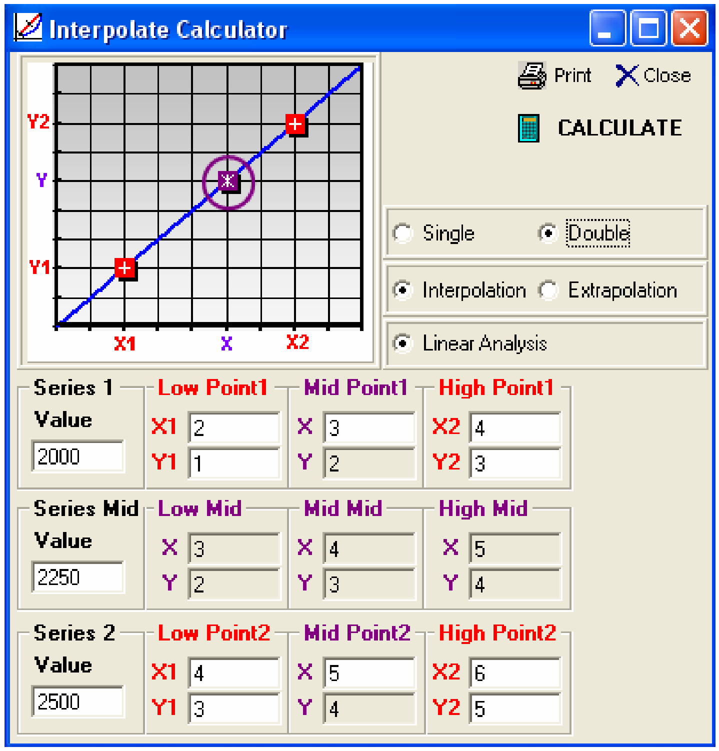
THERMAL COMFORT CALCULATOR

This Thermal Comfort Calculator models human comfort based on ASHRAE equations.



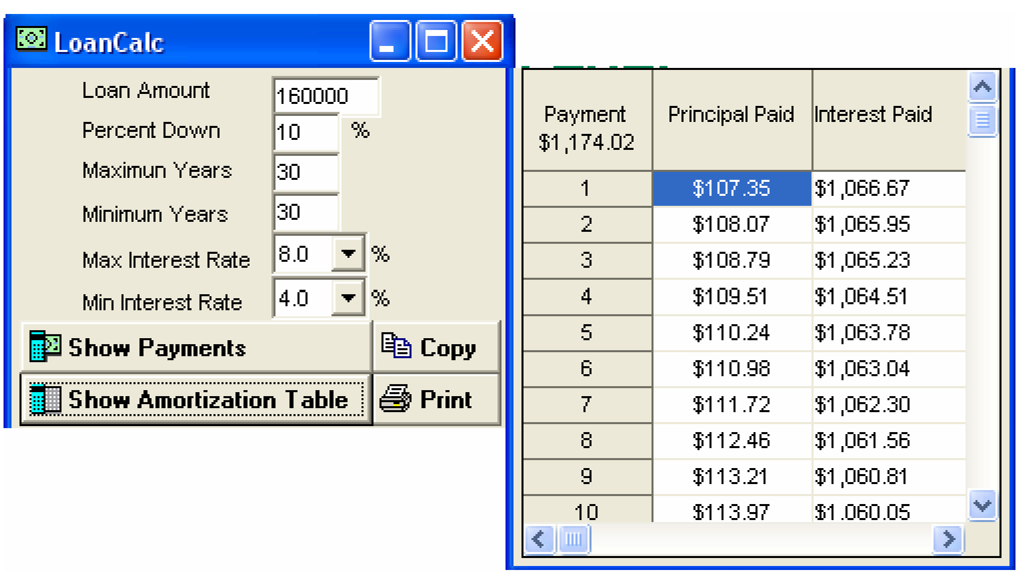
SINGLE & DOUBLE INTERPOLATION AND EXTRAPOLATION CALCULATOR

This interpolation and extrapolation calculator is extremely useful when needing to determine data between known values. Linear interpolation and extrapolation is used.



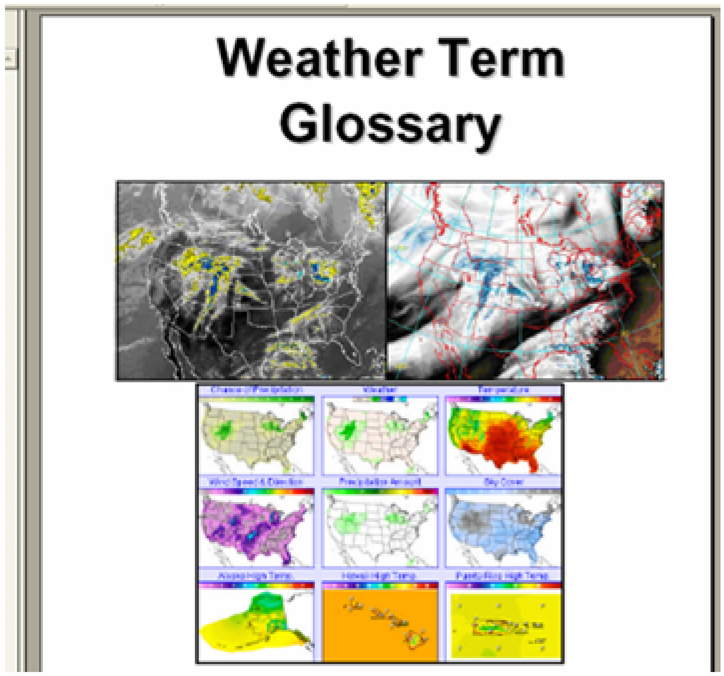
FINANCIAL LOAN CALCULATOR

This tool is helpful for quick "cost of money" determinations for project work.



WEATHER TERM GLOSSARY REFERENCE

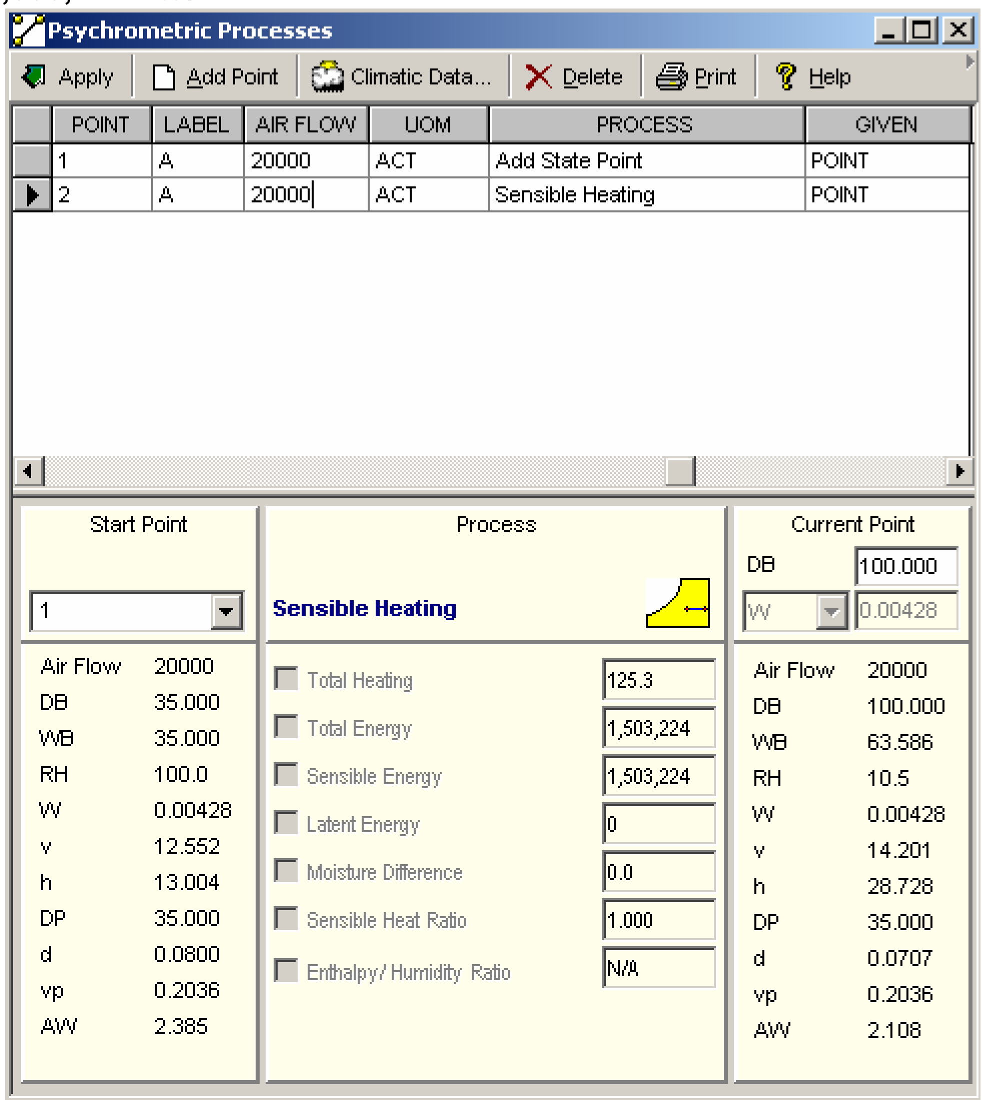
Meteorologist using Psychrometric Analysis will appreciate the complete weather term glossary provided with one button click.



EXAMPLE PROCESSES

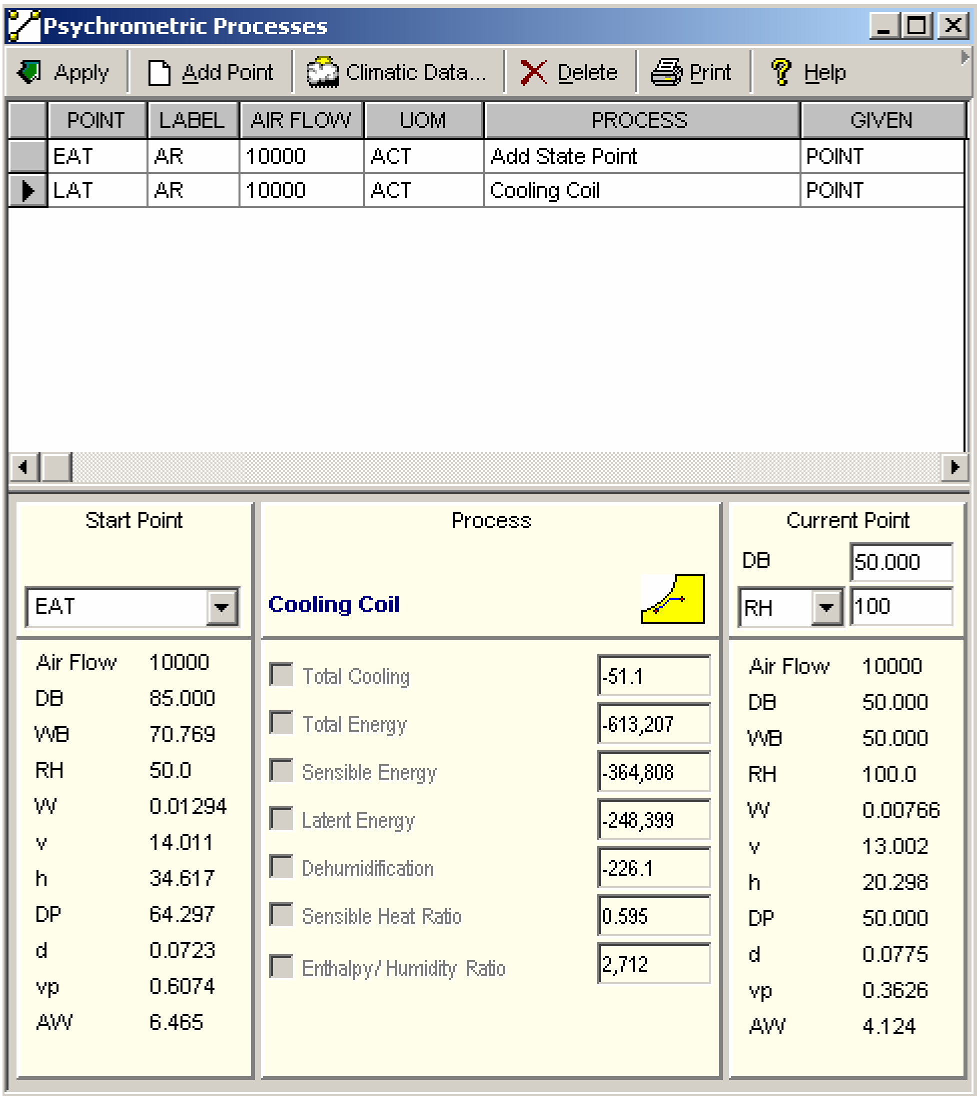
EXAMPLE 1:
Moist Air Sensible Heating

Saturated air at 35F enters a heating coil at 20,000cfm. Air leaves coil at 100F. Find the required rate of heat addition.
Solution: 1,503,224 Btu/h



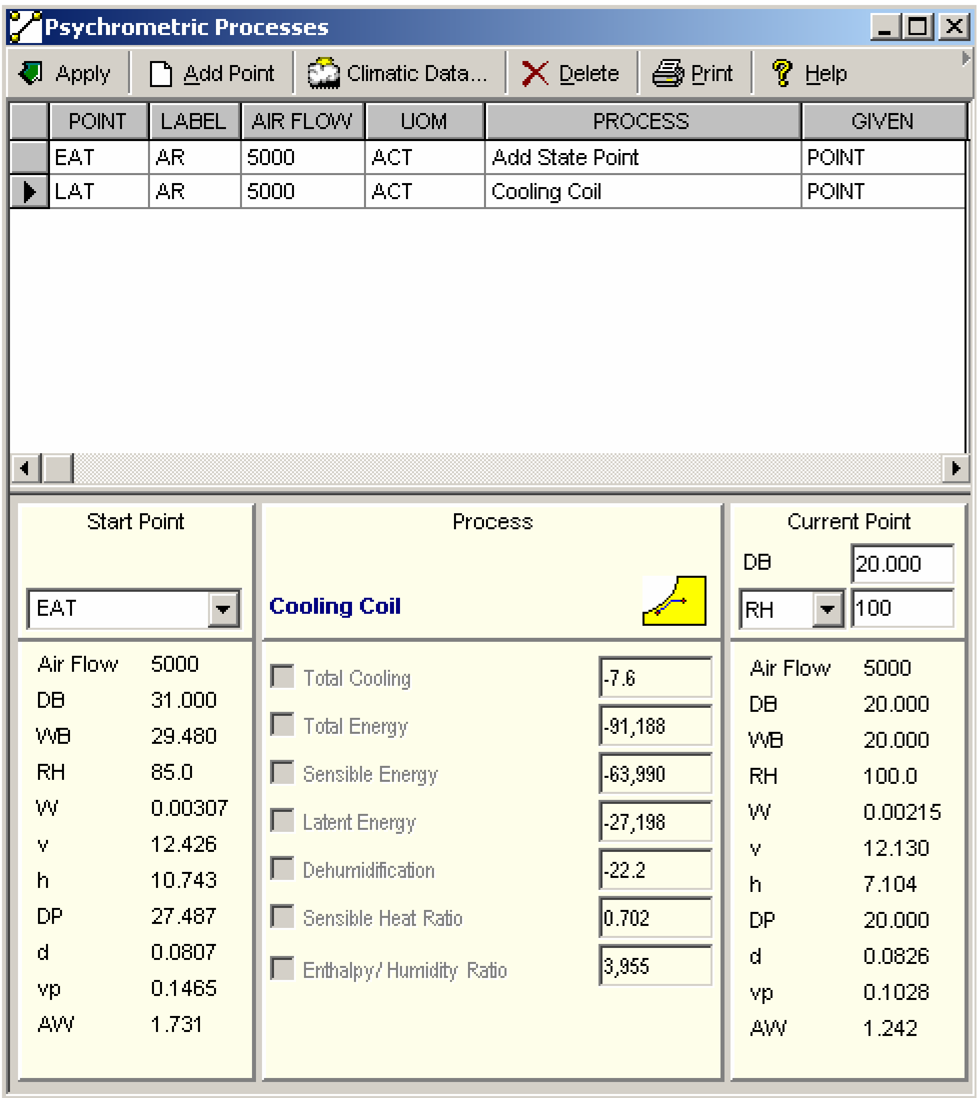
EXAMPLE 2:
Moist Air Cooling & Dehumidification

Problem: Moist air at 85F dry bulb and 50% rh enters a cooling coil at 10,000 cfm and is processed to a final condition at 50F and 100% rh. Find the tons of refrigeration required.
Solution: 51.1 tons



EXAMPLE 3:
Moist Air Cooling & Dehumidification Below Freezing

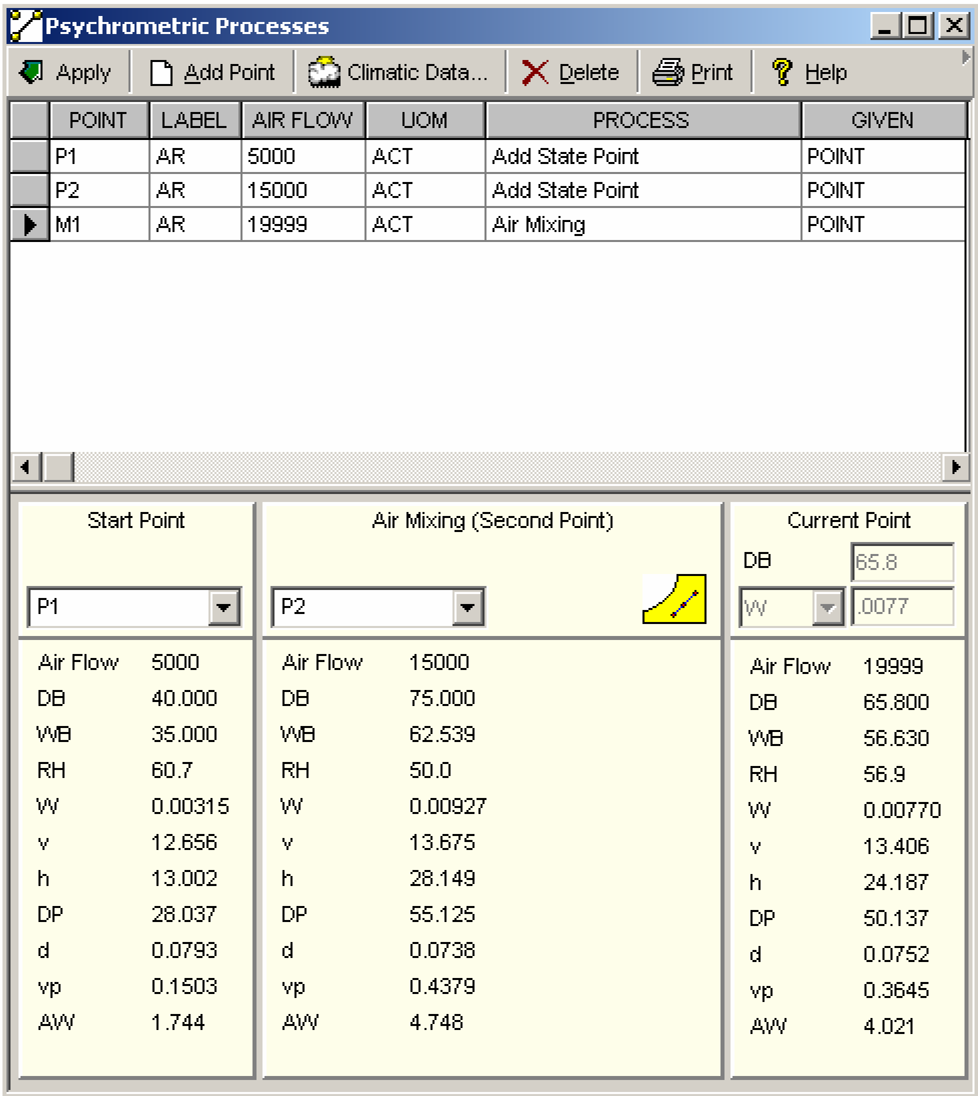
Problem: Moist air at 31F dry bulb and 85% rh enters a cooling coil at 5,000 cfm and is processed to a final condition at 20F and 100% rh. Find the tons of refrigeration required.
Solution: 7.6 tons



EXAMPLE 4:
Adiabatic Mixing of Two Moist Airstreams

Problem: A stream of 5000 cfm outdoor air at 40F dry-bulb temperature and 35F wet-bulb temperature is adiabatically mixed with 15,000 cfm of 75F dry-bulb temperature air and 50% rh. Find the resulting dry-bulb and wet-bulb temperatures.

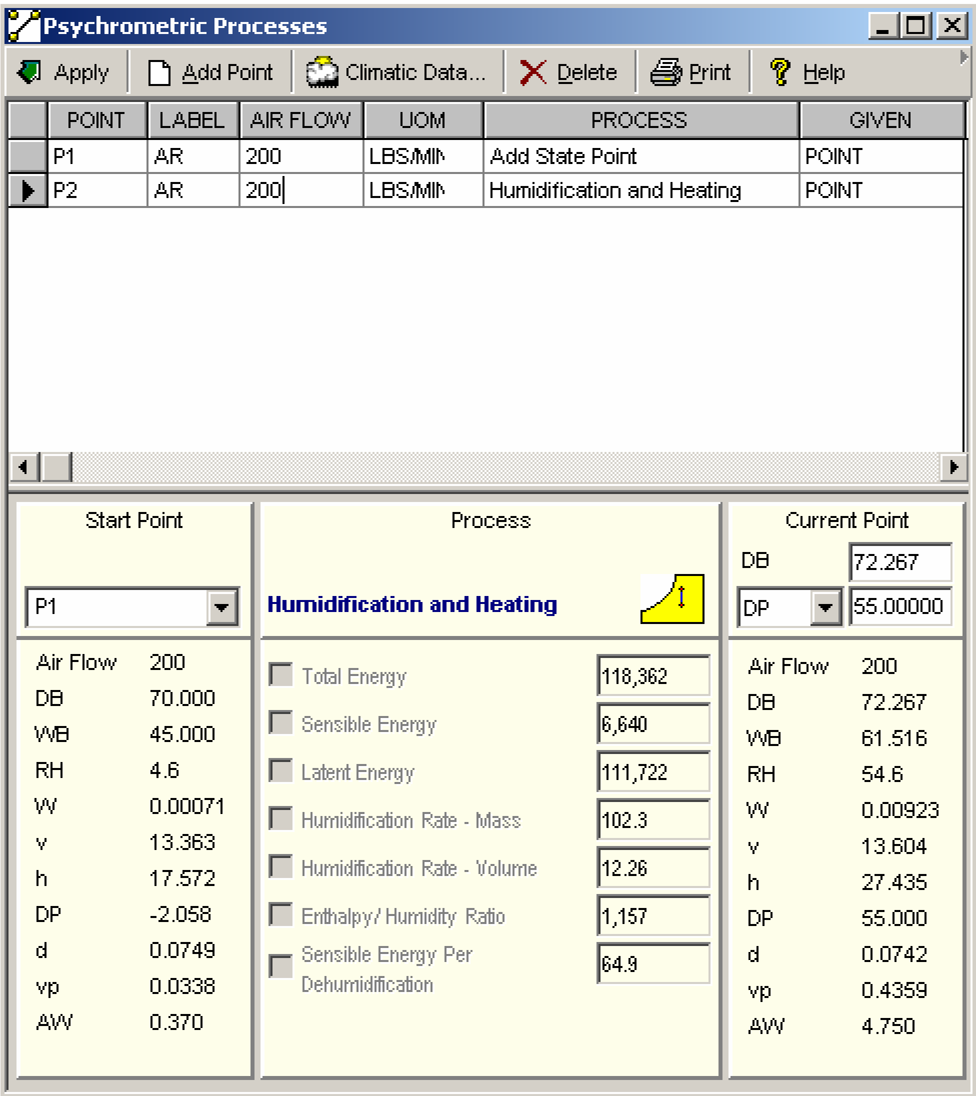
Solution: 65.8°Fdb & 56.6°Fwb



EXAMPLE 5: Adiabatic Mixing of Water Injected into Moist Air

Problem: Moist Air at 70F dry-bulb and 45F wet-bulb is to be processed to a final dew-point temperature of 55F by adiabatic injection of saturated steam at 230F. The rate of dry airflow is 200lbda/min and the final dry-bulb temperature is 72.267. Find the rate of steam flow required.

Solution: 102.3 lb/h

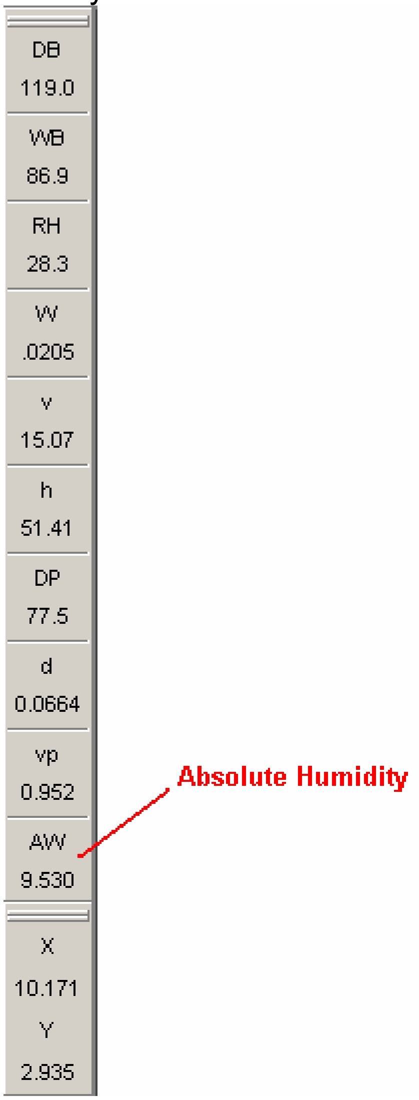


TERMINOLOGY

PSYCHROMETRIC TERM DEFINITIONS

Absolute Humidity

The ratio of the mass of water vapor to the total volume of a sample. The term "water vapor density" is also used for this value.



ASHRAE

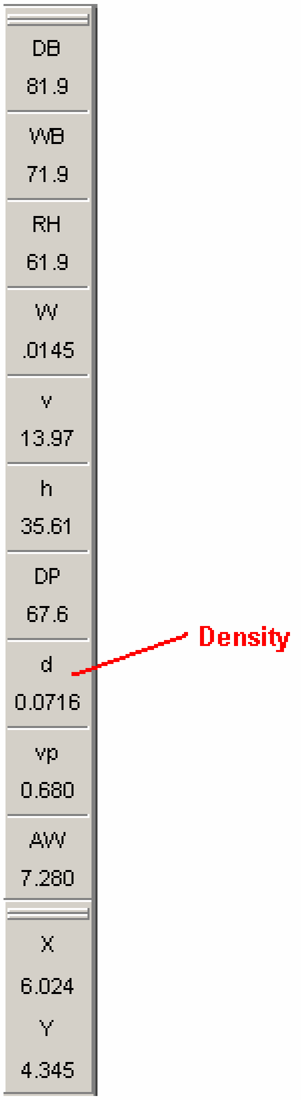
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Atmospheric Air

Air containing water vapor and many gaseous components such as smoke, pollen, gaseous pollutants, etc.

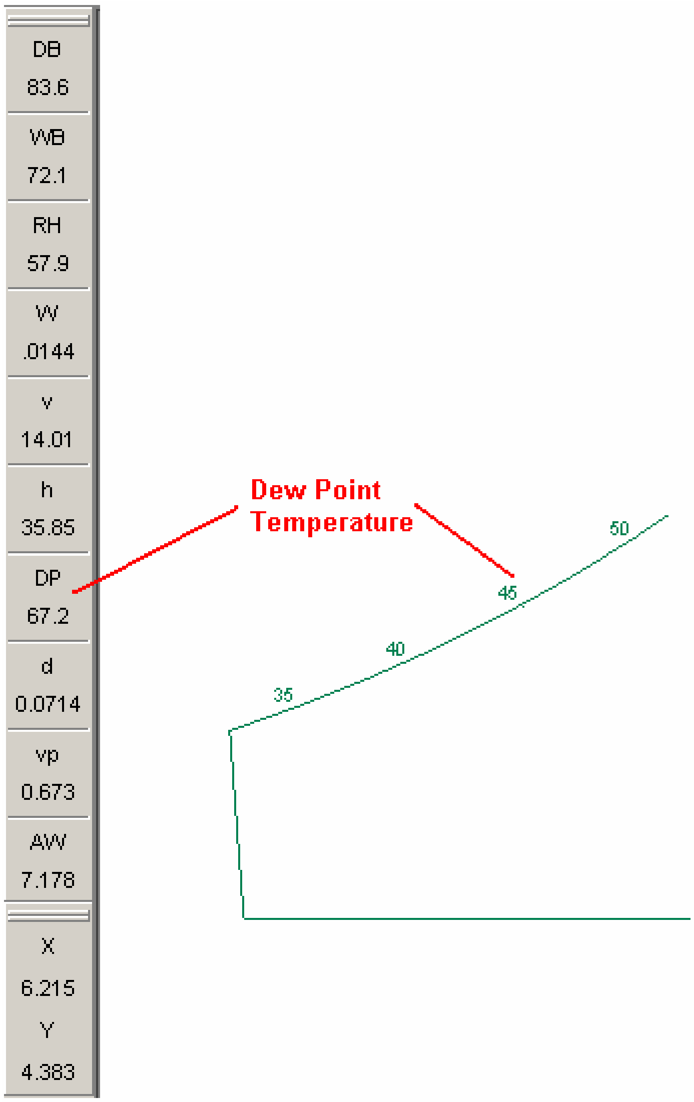
Density

The ratio of the total mass of a sample to the total volume of the sample. For moist air, water vapor and air are included in the totals.



Dew Point Temperature

The temperature of moist air saturated at the same pressure and humidity ratio. Or more simply the temperature at which water vapor will begin to condense from a sample of air.



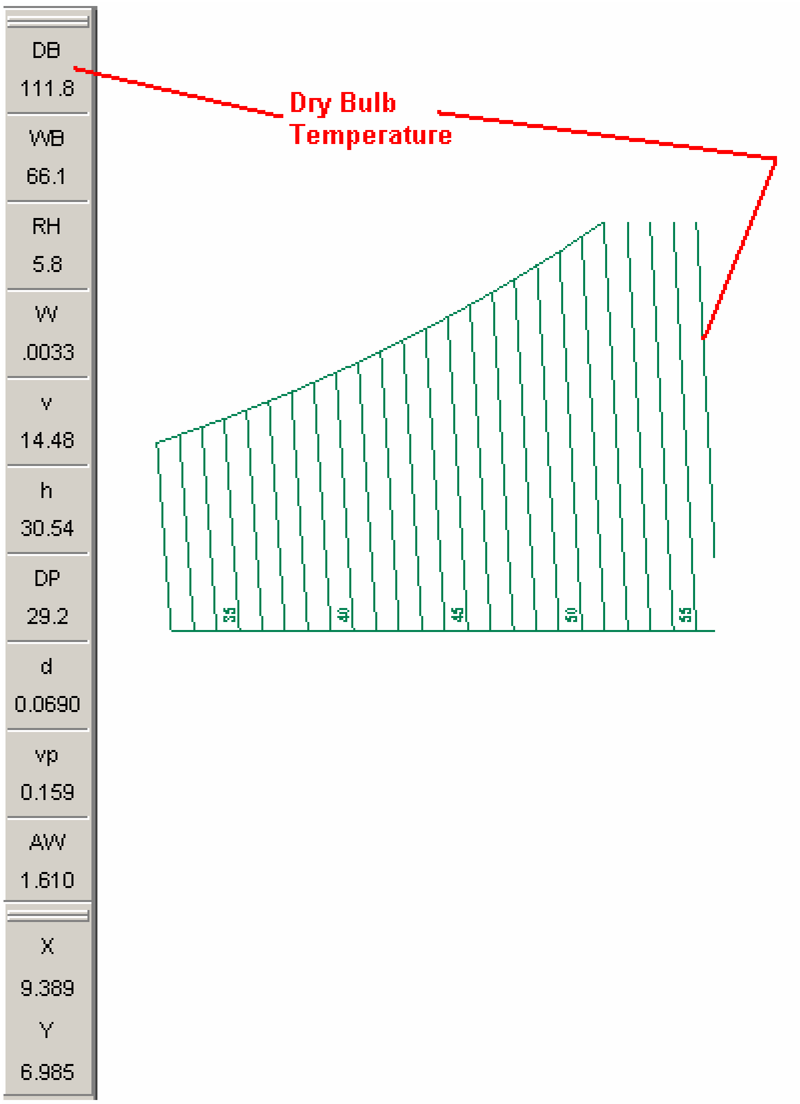
Dry Air

Atmospheric air with all water vapor and contaminants removed.
The approximate percentage by volume of dry air is as follows:

78.084 % Nitrogen
20.9476 % Oxygen
0.934 % Argon
0.0314 % Carbon Dioxide
0.001818 % Neon
0.000524 % Helium
0.00015 % Methane
0.00010 % Sulfer Dioxide
0.00005 % Hydrogen
0.00020 % Other (Krypton, Xenon, Ozone, etc.)

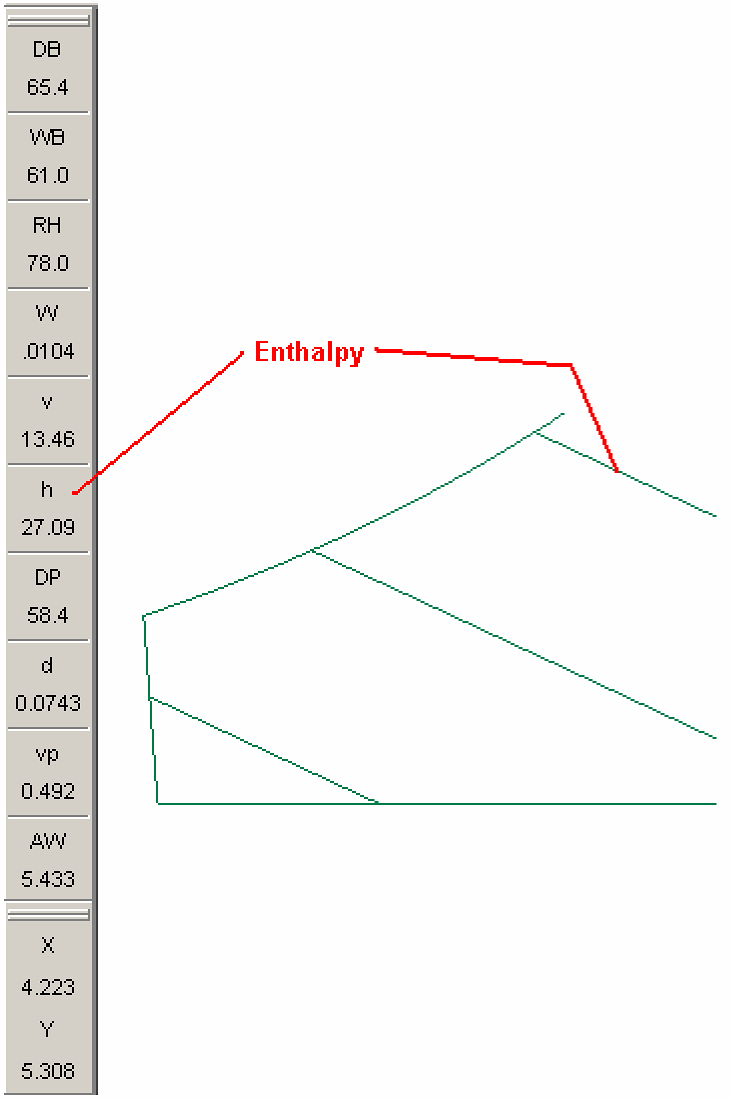
Dry Bulb Temperature

The temperature of air read on a standard thermometer indicating it's thermal state.



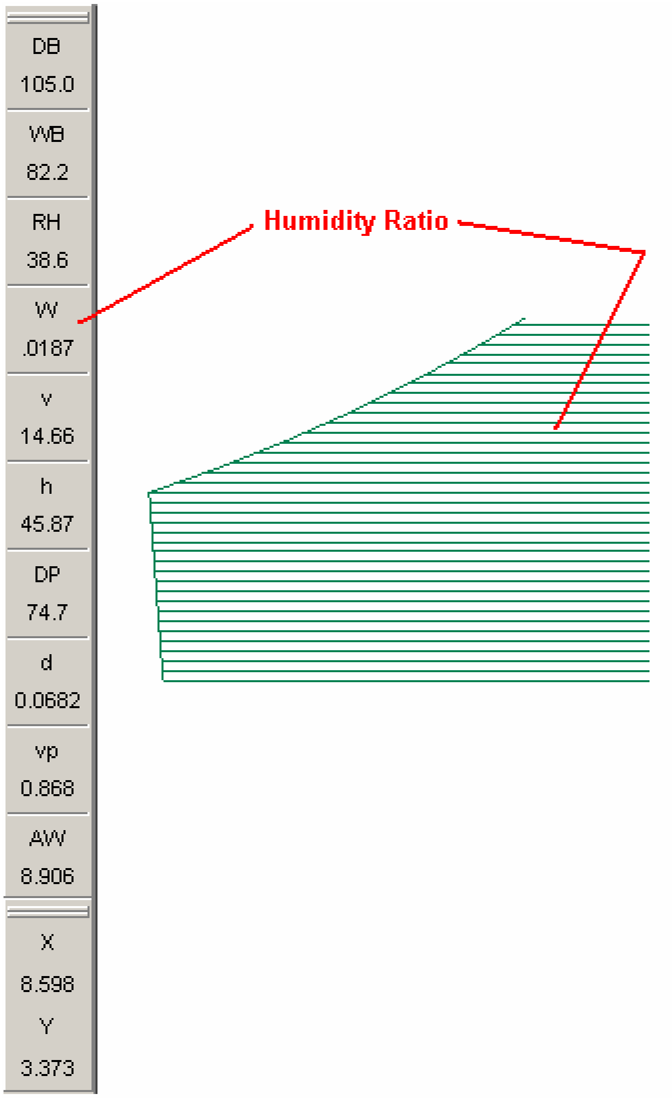
Enthalpy

The thermodynamic property defined as energy per unit mass commonly used to define the internal energy of moist air. The enthalpy of a sample of moist air is the sum of enthalpies of the air and the water vapor. On the psychrometric chart Enthalpy is expressed in terms of energy per weight of DRY air.



Humidity Ratio

The ratio of the mass of water vapor to the mass of dry air of a sample.



Moist Air

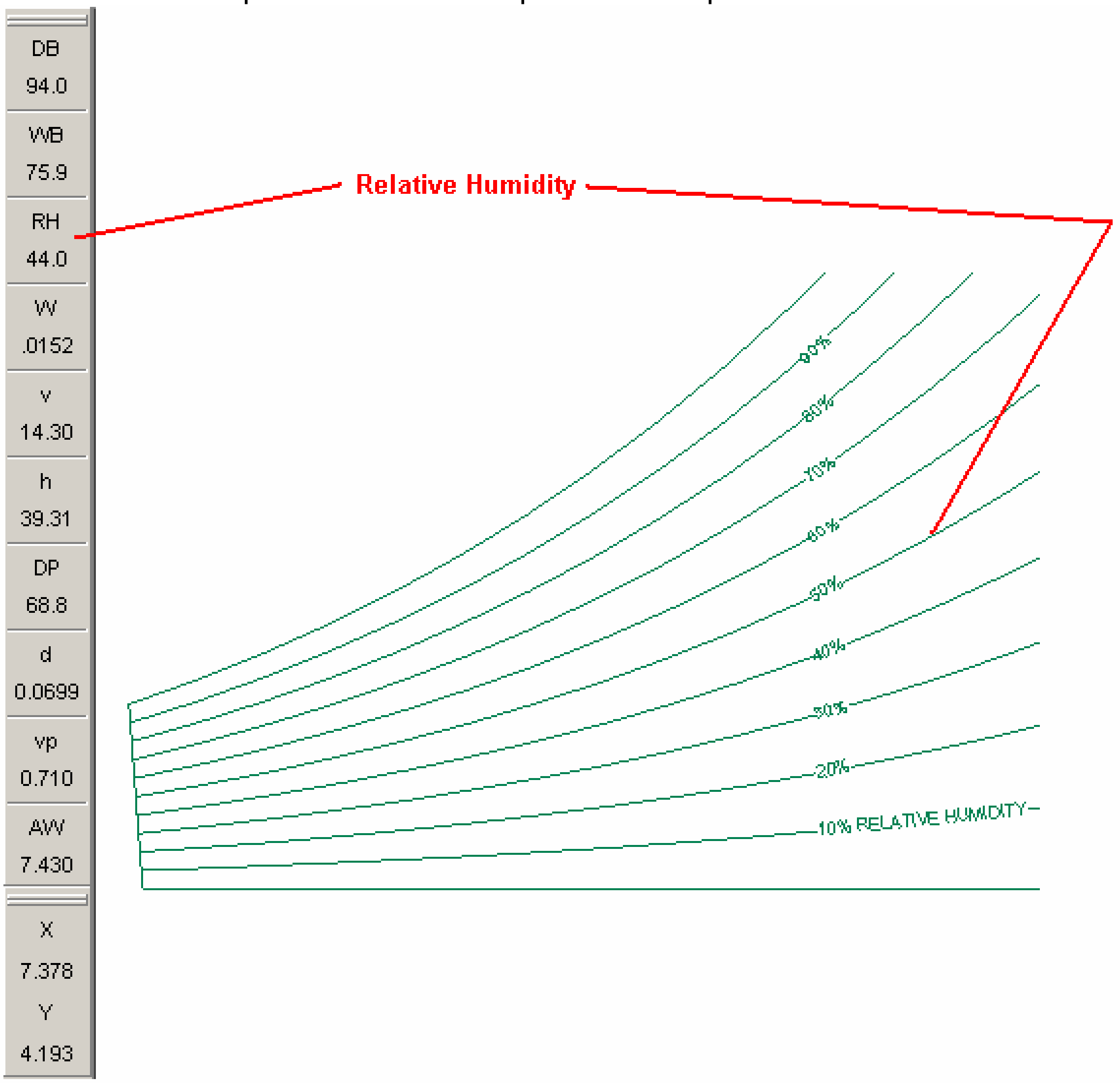
A binary (or two-component) mixture of dry air and water vapor.

Psychrometric Chart

A graphical presentation of the thermodynamic and physical properties of air and water vapor mixtures.

Relative Humidity

The ratio of mole fraction of water vapor in a given moist air sample to the mole fraction in a saturated air sample at the same temperature and pressure.



Saturation

A state of neutral equilibrium between moist air and the condensed water phase (liquid or solid). This state is often referred to as the maximum amount of water vapor in moist air at a given temperature and pressure.

Saturation Humidity Ratio

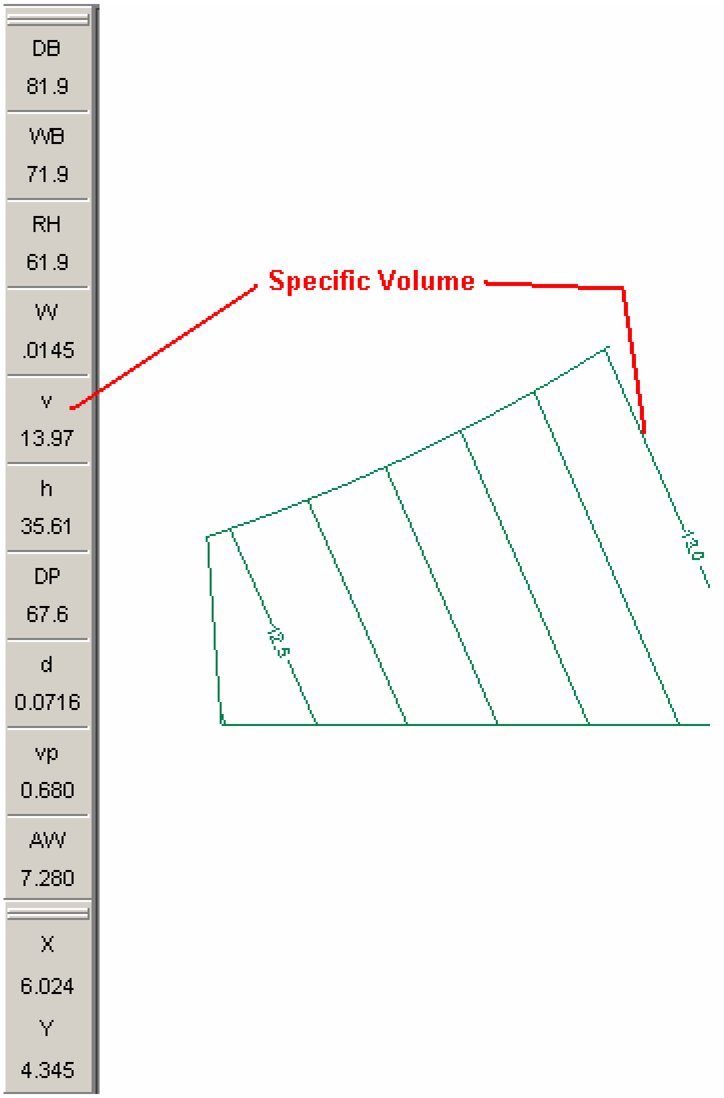
The humidity ratio of moist air saturated with respect to water (or ice) at the same temperature and pressure.

Specific Humidity

The ratio of the mass of water vapor to the total mass of moist air of a sample.

Specific Volume

The ratio of the total volume of air to the mass of dry air in a sample.



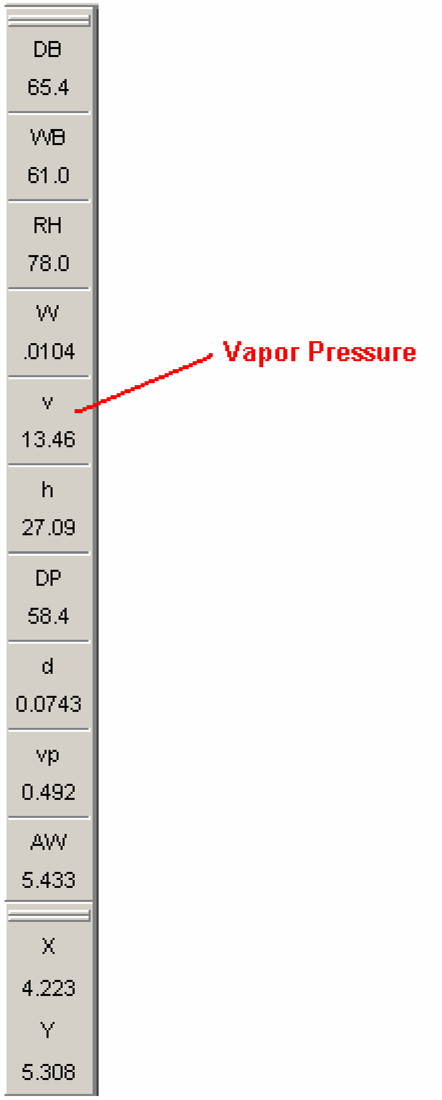
Standard Atmosphere

The standard of reference for estimating properties at various altitudes.

For HVAC purposes standard air is taken as 68°F and 29.921 inches Hg atmospheric pressure.

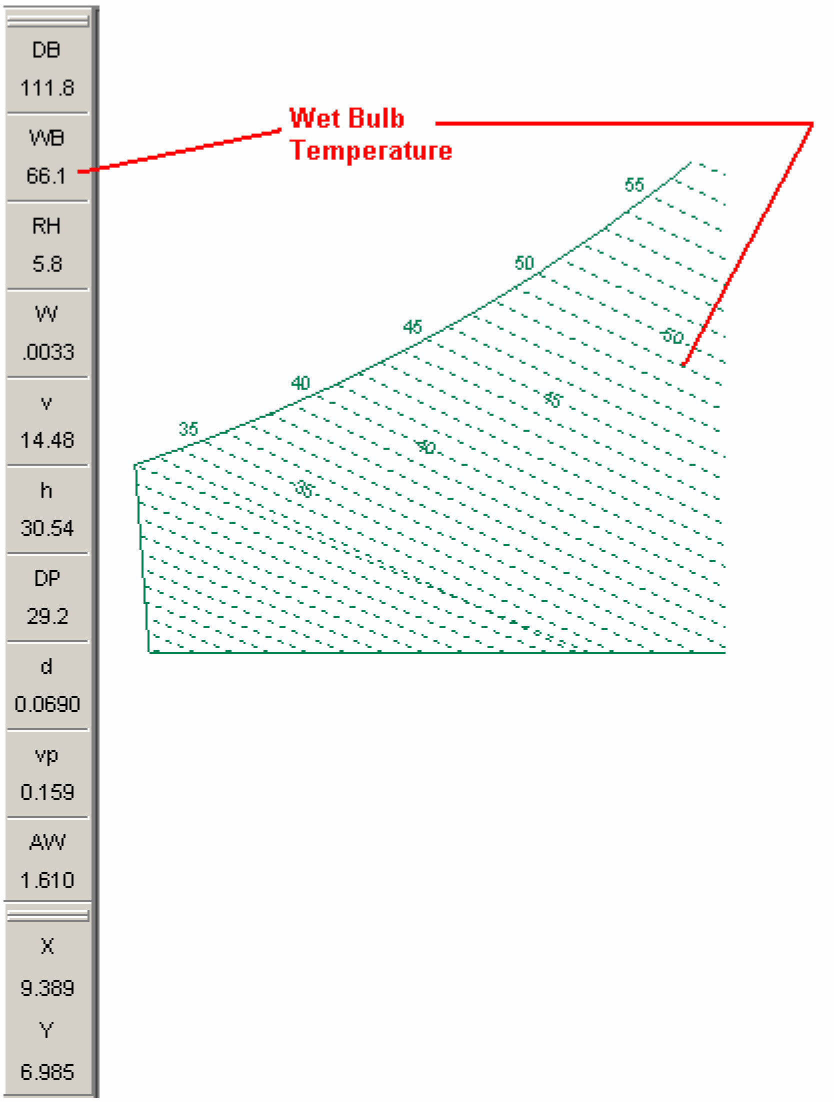
Vapor Pressure

Pressure exerted by a vapor.



Wet Bulb Temperature

The equilibrium temperature reached as water evaporates from a thoroughly wetted psychrometer wick into an airstream. While this process is not one of adiabatic saturation, by applying only small corrections one can obtain the thermodynamic wet-bulb temperature.



ALGORITHMS

PSYCHROMETRIC ALGORITHMS

The following is the methodology the program uses in determining the psychrometric properties of moist air:

Atmospheric Pressure

$$p = Atm \times (1 - 6.8753 \times 10^{-6} \times Z)^{5.2559}$$

p = inches of Mercury

Atm = 29.921299597519

Z = elevation in feet

Water Vapor Saturation Pressure

For 311.67°R <= T =< 491.67°R

$$pws = \exp\left(C_1 \div T + C_2 + C_3 \times T + C_4 \times T^2 + C_5 \times T^3 + C_6 \times T^4 + C_7 \times \ln(T)\right)$$

T = absolute temperature, °R = °F + 459.67

$C_1 = -1.0214165 \times E^4$

$C_2 = -4.8932428 \times E^0$

$C_3 = -5.3765794 \times E^{-3}$

$C_4 = 1.9202377 \times E^{-7}$

$C_5 = 3.5575832 \times E^{-10}$

$C_6 = -9.0344688 \times E^{-14}$

$C_7 = 4.1635019 \times E^0$

For 491.67°R < T =< 851.67°R

$$pws = \exp\left(C_8 \div T + C_9 + C_{10} \times T + C_{11} \times T^2 + C_{12} \times T^3 + C_{13} \times \ln(T)\right)$$

T = absolute temperature, °R = °F + 459.67

$C_8 = -1.0440397 \times E^4$

$C_9 = -1.1294650 \times E^1$

$C_{10} = -2.7022355 \times E^{-2}$

$C_{11} = 1.2890360 \times E^{-5}$

$C_{12} = -2.4780681 \times E^{-9}$

$C_{13} = 6.5459673 \times E^0$

Saturated Humidity Ratio

$$W_s = \frac{0.62198 \times f \times p_{ws}}{p - f \times p_{ws}}$$

p = total pressure of moist air

f = enhancement factor

p_{ws} = pressure of saturated pure water

Enhancement Factor

f = calculated in accordance with Hyland and Wexler (1973, "The Second")

Humidity Ratio

For t^* > 32°F

$$W = \frac{(1093 - 0.556 \times t^*) \times W_s^* - c_p \times (t - t^*)}{1093 + 0.444 \times t - t^*}$$

t^* = thermodynamic wet-bulb temperature of moist air, °F

t = dry-bulb temperature of moist air, °F

c_p = specific heat of moist air, Btu/lb°F

W_s^* = humidity ratio of moist air at saturation at thermodynamic wet-bulb temperature

For t^* <= 32°F

$$W = \frac{(1061 + 0.444 \times t^* - (-143.34 + 0.5 \times (t^* - 32))) \times W_s^* - c_p \times (t - t^*)}{1061 + 0.444 \times t^* - (-143.34 + 0.5 \times (t^* - 32))}$$

t^* = thermodynamic wet-bulb temperature of moist air, °F

t = dry-bulb temperature of moist air, °F

c_p = specific heat of moist air, Btu/lb°F

W_s^* = humidity ratio of moist air at saturation at thermodynamic wet-bulb temperature

Specific Heat

$$c_p = -2.0921943 \times 10^{-14} \times t^4 + 2.5588383 \times 10^{-11} \times t^3 + 1.2900877 \times 10^{-8} \times t^2 + 5.8045267 \times 10^{-6} \times t + 0.23955919$$

t = dry-bulb temperature of moist air, °F

Specific Volume

$$v = \frac{0.7543 \times (t + 459.67) \times (1 + 1.6078 \times W)}{p}$$

t = dry-bulb temperature of moist air, °F
W = humidity ratio of moist air, mass of water per unit mass of dry air
p = total pressure of moist air

Enthalpy

$$h = cp \times t + W \times (1061 + 0.444 \times t)$$

t = dry-bulb temperature of moist air, °F
W = humidity ratio of moist air, mass of water per unit mass of dry air
c_p = specific heat of moist air, Btu/lb°F

Wet Bulb

Iterative calculation calling **Humidity Ratio** function

Dew Point

Iterative calculation calling **Saturated Humidity Ratio** function

LEGAL NOTICES

LICENSING

Use License

When you purchase a single user license, Hands Down Software grants you a non-exclusive license to install and operate this software on one computer. Should you choose to purchase a Network License, Hands Down Software will grant you a non-exclusive license to install this software on one network server and operate the software on not more than the user limit provided by the licensing you have purchased.

In addition, Hands Down Software grants you the right to make an archive copy of this software and to use that copy to reinstall the software in cases where the original copy has been corrupted or destroyed. The limits of your license to use this software must be understood prior to installation.

Program Ownership and Copyright Notice

This is a license agreement not a sale of the original program or copies thereof. Hands Down Software retains all rights to the program and any and all subsequent copies which exist regardless of their form. Reproduction of this software by parties other than Hands Down Software for reasons beyond that which is specifically stated in this license agreement is strictly prohibited by international copyright laws. Charts produced by this software are copyright the OEM Company whose logo appears on the chart.

HDPsyChart was written by Hands Down Software and associates and may be distributed under agreement between Hands Down Software and other parties. This software uses algorithms that are generally accepted by the Heating, Ventilation and Air Conditioning (HVAC) industry and as such the results of these calculations should yield acceptable results for use in general HVAC work.

DISCLAIMER OF WARRANTIES

Hands Down Software and the distributors of this software do not warrant that the information in this software is free of errors. The program is provided "as is" without warranty of any kind, either expressed or implied. The entire risk as to the quality and performance of the program and data is with you. In no event will Hands Down Software be liable to you for any damages; including without limitation any lost profits, lost savings, or other incidental or consequential damages arising out of the use or inability to use this program and data.